

Fig. 9E is a scale drawing of an embodiment of the stent of the present invention;

Fig. 9F is a scale drawing of an embodiment of the stent of the present invention;

Fig. 9G is an enlarged view of a single connecting strut joining two expansion strut pairs in accordance with an embodiment of the present invention;

Fig. 10A is a drawing of an alternate geometry of connecting struts and joining struts in accord with the present invention;

Fig. 10B is a drawing of an alternate geometry of connecting struts and joining struts in accord with the present invention;

Fig. 10C is a drawing of an alternate geometry of connecting struts and joining struts in accord with the present invention;

Fig. 10D is a drawing of an alternate geometry of connecting struts and joining struts in accord with the present invention;

Fig. 10E is a drawing of an alternate geometry of connecting struts and joining struts in accord with the present invention;

Fig. 10F is a drawing of an alternate geometry of connecting struts and joining struts in accord with the present invention; and

Fig. 11 is a delivery balloon catheter, illustrating a method of deliver of a stent in accord with the present invention.

DETAILED DESCRIPTION

A first embodiment of the present invention is shown in Figures 1A, 1B, 1C, 2A and 2B. Referring to Figure 1A, an elongate hollow tubular stent 10 in an unexpanded state is shown. A proximal end 12 and a distal end 14 define a longitudinal length 16 of stent 10. The longitudinal length 16 of the stent 10 can be as long as 100 mm or longer. A proximal opening 18 and a distal opening 20 connect to an inner lumen 22 of stent 10. Stent 10 can be a single piece, without any seams or welding joints or may include multiple pieces.

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Stent 10 is constructed of two to fifty or more expansion columns or rings 24 connected together by interspersed connecting strut columns 26. The first column on the proximal end 12 and the last column on the distal end 14 of stent 10 are expansion columns 24.

Expansion columns 24 are formed from a series of expansion struts 28, and joining struts 30. Expansion struts 28 are thin elongate members arranged so that they extend at least in part in the direction of the longitudinal axis of stent 10. When an outward external force is applied to stent 10 from the inside by an expansion balloon or other means, expansion struts 28 are reoriented such that they extend in a more circumferential direction, i.e. along the surface of cylindrical stent 10 and perpendicular to its longitudinal axis. Reorientation of expansion struts 28 causes stent 10 to have an expanded circumference and diameter. In Figure 1A, expansion struts 28 of unexpanded stent 10 are seen to extend substantially parallel to the longitudinal axis of stent 10.

Expansion struts 28 are joined together by joining struts 30 to form a plurality of expansion strut pairs 32. Expansion strut pairs have a closed end 34 and an open end 36. Additional joining struts 30 join together expansion struts 28 of adjacent expansion strut pairs 32, such that expansion struts 28 are joined alternately at their proximal and distal ends to adjacent expansion struts 28 to form expansion columns 24. Each expansion column 24 contains a plurality, typically eight to twenty, twenty to sixty, or larger of expansion struts 28. Expansion columns are preferably continuous unbroken ring structures extending around the circumference of the stent 10; however, broken structures in which individual struts or pieces of struts are removed from an otherwise continuous expansion column 24 can also be used.

Connecting struts 38 connect adjacent expansion columns 24 forming a series of interspersed connecting strut columns 26 each extending around the circumference of stent 10. Each connecting strut 38 joins a pair of expansion struts 28 in an expansion column 24 to an adjacent pair of expansion struts 28 in an adjacent expansion column 24. For stent 10 of Figure 1A, the ratio of expansion struts 28 in an expansion column 24 to connecting struts 38 in a

connecting strut column 26 is two to one; however, this ratio in general can be x to 1 where x is greater or less than two. Furthermore, since the stent 10 of Figure 1A begins with an expansion column 24 on the proximal end 12 and ends with an expansion column 24 on the distal end 14, if there are n expansion columns 24 with m expansion struts 28 per column, there will be $m-1$ connecting strut columns 26, and $n(m-1)/2$ connecting struts 38.

The reduced number of connecting struts 38 in each connecting strut column 26, as compared to expansion struts 28 in each expansion column 24, allows stent 10 to be longitudinally flexibility. Longitudinal flexibility can be further increased by using a narrow width connecting strut, providing additional flexibility and suppleness to the stent as it is navigated around turns in a natural blood vessel.

At least a portion of the open spaces between struts in stent 10 form asymmetrical cell spaces 40. A cell space or geometric cell is an empty region on the surface of stent 10, completely surrounded by one or a combination of stent struts, including expansion struts 28, connecting struts 38, or joining struts 30. Asymmetrical cell spaces 40 are cell spaces which have no geometrical symmetry i.e. no rotation, reflection, combination rotation and reflection or other symmetry. Asymmetrical cell spaces 40 have an asymmetrical geometric configuration.

Asymmetrical cell spaces 40 in Figure 1A are surrounded by a first expansion strut pair 32 in a first expansion column 24, a first connecting strut 38, a second expansion strut pair 32 in an adjacent expansion column 24, a first joining strut 30, a second connecting strut 38, and a second joining strut 30. Furthermore, expansion strut pairs 32 of asymmetrical cell space 40 may be circumferentially offset i.e. have longitudinal axes that are not collinear and have their open ends 36 facing each other. The space between two expansion struts of an expansion strut pair 32 is known as a loop slot 42.

Figure 1B shows inner lumen 22, radius 44 and stent wall 46 of stent 10. Stent wall 46 consists of stent struts including expansion struts 28, connecting struts 38 and joining struts 30.

Figure 1C shows, proximal end 12, distal end 14, longitudinal length 16, inner lumen 22, and stent wall 46 of stent 10. Inner lumen 22 is surrounded by stent wall 46 which forms the cylindrical surface of stent 10.

Referring now to Figures 2A and 2B, joining struts 30 of stent 10 are seen to extend at an angle to the expansion struts 28, forming a narrow angle 48 with one expansion strut 28 in an expansion strut pair 32 and a wide angle 50 with the other expansion strut 28 of an expansion strut pair 32. Narrow angle 48 is less than ninety degrees, while wide angle 50 is greater than ninety degrees. Joining struts 30 extend both longitudinally along the longitudinal axis of stent 10 and circumferentially, along the surface of the stent 10 perpendicular to its longitudinal axis.

Expansion strut spacing 52 between adjacent expansion struts 28 in a given expansion column 24 are uniform in stent 10 of Figures 2A and 2B; however, non-uniform spacings can also be used. Expansion strut spacings 52 can be varied, for example, spacings 52 between adjacent expansion struts 28 in an expansion column 24 can alternate between a narrow and a wide spacings. Additionally, spacings 52 in a single expansion column 24 can differ from other spacings 52 in other columns 24.

It is noted that varying expansion strut spacings 52 which form the loop slots 42 results in variable loop slot widths. Furthermore, the longitudinal axis of the loop slots 42 need not be collinear or even parallel with the longitudinal axis of loop slots 42 of an adjacent expansion column 24. Figures 2A and 2B show an arrangement of expansion struts 28 such that collinear, parallel adjacent loop slots 42 are formed, but non-collinear and non-parallel loop slots 42 can also be used.

Additionally the shape of loop slots 42 need not be the same among loop slots of a single or multiple expansion columns 24. The shape of loop slots 42 can be altered by changing the orientation or physical dimensions of the expansion struts 28 and/or joining struts 30 which connect expansion struts 28 of expansion strut pairs 32 defining the boundaries of loop slots 42.

Connecting struts 38 couple adjacent expansion columns 24, by connecting the distal end of an expansion strut pair in one expansion column 24 to the proximal end of an adjacent expansion strut pair 32 in a second expansion column 24. Connecting struts 38 of Figures 2A and 2B are formed from two linear sections, a first linear section 54 being joined at its distal end to a second linear section 56 at its proximal end to form a first slant angle 58.

The first linear section 54 of a connecting strut 38 is joined to expansion strut 28 at the point where joining strut 30 makes narrow angle 48 with expansion strut 28. First linear section 54 extends substantially collinear to joining strut 30 continuing the line of joining strut 30 into the space between expansion columns 24. The distal end of the first linear section 54 is joined to the proximal end of the second linear section 56 forming slant angle 58. Second linear section 56 extends substantially parallel to expansion struts 28 connecting at its distal end to joining strut 30 in an adjacent expansion column 24. The distal end of second linear section 56 attaches to expansion strut 28 at the point where joining strut 30 makes narrow angle 48 with expansion strut 28. Further, joining strut 30 can have a second slant angle with a width that can be the same or different from the width of the first slant angle.

Figures 2A and 2B show connecting struts 38 and joining struts 30 slanted relative to the longitudinal axis of stent 10, with the circumferential direction of the slanted struts alternating from column to adjacent column. Circumferential direction refers to the handedness with which the slanted struts wind about the surface of the stent 10. The circumferential direction of the slant of connecting strut first linear sections 54 in a connecting strut column 26 is opposite the circumferential direction of the slant of connecting strut first linear sections 54 in an adjacent connecting strut column 26. Similarly, the circumferential direction of the slant of joining struts 30 in an expansion column 24 is opposite the circumferential direction of the slant of joining struts 30 in an adjacent expansion column 24. Alternating circumferential slant directions of connecting struts 38 and joining struts 30 prevents axial warping

of stent 10 during deliver and expansion. Other non-alternating slant direction patterns can also be used for connecting struts 38 or joining struts 30 or both.

Figure 3A and 3B show a schematic illustration of a stent design according to the present invention in an unexpanded and expanded state respectively. The design is depicted as a flat projection, as if stent 10 were cut lengthwise parallel to its longitudinal axis and flattened out. The connecting struts 38 consist of first and second linear sections 54 and 56 forming slant angle 58 at pivot point 60. An asymmetrical cell space 40 is formed by expansion strut pairs 32, connecting struts 38 and joining struts 30. Multiple interlocking asymmetrical cell spaces 40 make up the design pattern.

As the stent is expanded, see Figure 3B, the expansion strut pairs 32 spread apart at their open ends 36, shortening the length of expansion struts 28 along the longitudinal axis of the cylindrical stent. The longitudinal shortening of expansion struts 28 during expansion is countered by the longitudinal lengthening of connecting struts 38. The widening of slant angle 58 during expansion straightens connecting struts 38 and lengthens the distance between the coupled expansion strut pairs 32. The widening of the slant angle of connecting struts 38 substantially compensates for the longitudinal shortening of expansion struts 28. Thus, the stent has substantially constant unexpanded and expanded longitudinal lengths.

When the stent is expanded, each expansion column 24 becomes circumferentially stretched, enlarging the space between struts. The interlinking of expansion columns 24 by connecting struts 38 that have been straightened through the expansion process gives the stent 10 a high radial support strength. The entire stent 10 when expanded is unitized into a continuous chain mesh of stretched expansion columns 24 and connecting strut columns 26 forming an asymmetrical interlocking cell geometry which resists collapse both axially and radially. When the stent is expanded it has increased rigidity and fatigue tolerance.

In addition, efficient bending and straightening of connecting struts 38 at pivot points 60 allows increased longitudinal flexibility of the stent. For the

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stent to bend longitudinally, at least some of connecting struts 38 are forced to bend in their tangent plane. The tangent plane of a specific connecting strut 38 refers to the plane substantially tangent to the cylindrical surface of the stent at that connecting strut 38. The width of connecting struts 38 can be twice as wide as a thickness. Preferably, a one-to-one ratio is preferred. However, pivot points 60 in connecting struts 38 provide connecting struts 38 a flexible joint about which to more easily bend increasing longitudinal flexibility of the stent.

Referring to Figures 4A and 4B, a variation of the first embodiment of stent 10 of the present invention is shown. In this variation, stent 10 has a length 16 of 33.25 mm and an uncrimped and unexpanded circumference 88 of 5.26 mm. Fifteen expansion columns 24 are interspersed with connecting strut columns 26. Each expansion column 24 consists of twelve expansion struts 28 joined alternately at their proximal and distal ends by joining struts 30 forming six expansion strut pairs 32. Expansion struts 28 are aligned parallel to the longitudinal axis of cylindrical stent 10. Joining struts 30 form a narrow angle 48 and a wide angle 50 with the respective expansion struts 28 of expansion strut pairs 32. Adjacent expansion columns 24 employ alternating circumferential slant directions of joining struts 30.

In this variation of the first embodiment, expansion strut width 62 is .20 mm, expansion strut length 64 is 1.51 mm, and connecting strut width 66 is .13 mm. Distance 68 from the outer edge of a first expansion strut 28 to the outer edge of a second adjacent expansion strut 28 in the same expansion column 24 is .64 mm, leaving a loop slot width 70 of .24 mm.

In this variation of the first embodiment, connecting struts 38 consist of a slanted first linear section 54 joined to a second linear section 56 at a slant angle 58. First linear section 54 is slightly longer than second linear section 56 and is attached at its proximal end to an expansion strut 28 in an expansion column 24. The attachment of the proximal end of first linear section 54 to expansion strut 28 is at the point where joining strut 30 makes narrow angle 48 with expansion strut 28. First linear section 54 extends substantially collinear to joining strut 30 attaching at its distal end to the proximal end of second

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linear section 56 to form slant angle 58. Second linear section 56 extends substantially collinear to expansion struts 28, attaching at its distal end to an expansion strut 28 in an adjacent expansion column 24. The attachment occurs at the point where expansion strut 28 forms narrow angle 48 with joining strut 30. Joining struts 30 and connecting strut first linear sections 54 slant in alternating circumferential directions from column to adjacent column.

The joining of connecting struts 38 and expansion struts 28 at the point where narrow angle 48 is formed aids smooth delivery of stent 10 by streamlining the surface of the unexpanded stent and minimizing possible catching points. Bare delivery of stent 10 to the target lesion in a vessel will thus result in minimal snagging or catching as it is navigated through turns and curvatures in the vessel. Stent 10 behaves like a flexible, tubular sled as it is moved forward or backward in the vessel on the delivery catheter, sliding through tortuous vessels and over irregular bumps caused by atherosclerotic plaques inside the vessel lumen.

When fully expanded Stent 10 of Figures 4A and 4B has an internal diameter of up to 5.0 mm, while maintaining an acceptable radial strength and fatigue tolerance. The crimped stent outer diameter can be as small as 1.0 mm or less depending on the condition of the underlying delivery balloon profile; A small crimped outer diameter is especially important if stent delivery is to be attempted without predilation of the target site. When the stent is optimally crimped over the delivery balloon, the surface of the crimped stent is smooth allowing for no snagging of the stent struts during either forward or backward movement through a vessel.

Figure 5 shows a second embodiment of the present invention in which the stent 10 in its expanded form has a gradual taper from proximal end 12 to distal end 14. The shaded segments 72, 74, 76, 78, 80, 82 and 84 of expansion struts 28 represent regions of expansion struts 28 to be removed. Removal of the shaded segments 72, 74, 76, 78, 80, 82 and 84 provides stent 10 with a gradual taper when expanded with distal end 14 having a smaller expanded diameter than proximal end 12. The degree of shortening of the expanded

diameter of the stent 10 at a given expansion column 24 will be proportional to the length of the removed segment 72, 74, 76, 78, 80, 82, or 84 at that expansion column 24. In the expanded stent 10 the shortened expansion struts 28 will have a shortened component along the circumference of the stent resulting in a shortened circumference and diameter. The tapered diameter portion can be positioned anywhere along the length of stent 10, and the tapering can be made more or less gradual by removing appropriately larger or smaller portions of the expansion struts 28 in a given expansion column 24.

Tapering is especially important in long stents, longer than 12 mm, since tapering of blood vessels is more pronounced over longer lengths. A long stent with a uniform stent diameter can only be matched to the target vessel diameter over a short region. If the proximal vessel size is matched with the stent diameter, the expanded distal end of the stent will be too large for the natural vessel and may cause an intimal dissection of the distal vessel by stent expansion. On the other hand, if the distal vessel size is matched with the stent diameter, the proximal end of the expanded stent will be too small to set inside the vessel lumen. It is therefore desirable to have a stent with a tapered expanded diameter.

Another way to achieve a tapered expanded stent is to change the stiffness of the stent struts, expansion struts, connecting struts or joining struts such that the stiffness of the struts varies along the length of the stent. The stiffness of the struts can be changed by altering length, width or thickness, adding additional stiffening material, using a chemical or mechanical means to alter the physical properties of the stent material, or applying one or a series of elastic elements about the stent.

Along with the use of a tapered diameter stent, a matching tapered balloon catheter would ideally be made for delivery and deployment of the tapered diameter stent. The method of using a tapered matching balloon catheter with a tapered diameter stent is within the scope of the present invention.

Using a tapered balloon to expand a non-tapered stent will also achieve a tapered expanded stent; however, since no metal is removed from the stent, the stent is tapered as a result of incomplete expansion. The stent will therefore have increased metal fraction at the tapered end resulting in increased risk of acute thrombosis. Metal fraction is the proportion of the surface of the expanded stent covered by the stent strut material. Shortening the expansion struts as shown in Figure 5 allows for a tapered expanded stent with substantially constant metal fraction along its length.

A third embodiment of the present invention shown in Figures 6A and 6B has multiple reinforcement expansion columns 86 placed along the length of the stent 10. The ^{reinforcement} Reinforcement columns 86 are placed along the stent length to provide additional localized radial strength and rigidity to stent 10. Additional strength and rigidity are especially important at the ends of the stent to prevent deformation of the stent both during delivery and after placement. During delivery the stent ends can catch on the vessel wall possibly deforming the unexpanded stent and altering its expansion characteristics. After the stent has been placed it is important that the stent ends are rigid so that they set firmly against the vessel wall; otherwise, during a subsequent catheter procedure, the catheter or guidewire can catch on the stent ends pulling the stent away from the vessel wall and possibly damaging and/or blocking the vessel.

The specific variation of the third embodiment of stent 10 depicted in Figures 6A and 6B has a length 16 of 20.70 mm and an uncrimped and unexpanded circumference 88 of 5.26 mm. The stent 10 consists of six expansion columns 24 and three reinforcement expansion columns 86, each consisting respectively of twelve expansion struts 28 or reinforcement expansion struts 90. The reinforcement expansion columns 86 are positioned one at either end, and one along the length of the stent 10.

The expansion strut width 62 is .15 mm, reinforcement expansion strut width 92 is .20 mm, and the connecting strut width 66 is .10 mm. The narrow angle 48 formed by joining strut 30 and expansion strut 28 is 75 degrees, and

the narrow angle 94 formed by reinforcement joining strut 96 and reinforcement expansion strut 90 is 60 degrees.

Other arrangements of reinforcement expansion columns 86, such as providing reinforcement expansion columns 86 only on the ends of the stent, only on one end, or at multiple locations throughout the length of the stent can also be used and fall within the scope of the present invention. A taper can also be programmed into the reinforced stent 10 by shortening expansion struts 28 and reinforcement expansion struts 90 in appropriate expansion columns 24 and 86.

A fourth embodiment of the present invention, shown in the Figures 7A, 7B and 7C, is similar to the third embodiment but has the added feature of relief notches 98 and 100. A relief notch is a notch where metal has been removed from a strut, usually at a joint where multiple struts are connected. Relief notches increase flexibility of a strut or joint by creating a thinned, narrow region along the strut or joint. Relief notch 98 is formed at the joint formed between first linear section 54 of connecting strut 38 and expansion strut 28. Relief notch 100 is formed at the joint between second linear section 56 of connecting strut 38 and expansion strut 28. The positioning of the relief notches gives added flexibility to the unexpanded stent and prevents warping at the joints when the stent is expanded. This results in a smooth surface modulation to the expanded stent frame. Relief notches can be placed at other joints and can be included in any of the previously mentioned embodiments.

Figures 8A and 8B show a side elevation view of a variation of the fifth embodiment of the stent of the present invention. In this embodiment a four piece slanted connecting strut 38 is used to couple the corner of an expansion strut pair 32 in one expansion column 24 to the joining strut 30 of a circumferentially offset expansion strut pair 32 in an adjacent expansion column 24. The expansion struts 28, joining struts 30, expansion columns 24, reinforcement expansion struts 90, reinforcement joining struts 96, and reinforcement expansion columns 86 are substantially similar to the fourth embodiment of Figure 6A. Connecting struts 38 in connecting strut columns

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26, however, have an altered geometry and connectivity, described in more detail below.

Figure 8A shows only the stent struts on the front half of the stent surface. The stent struts on the rear half of the stent surface are not shown. The stent appears as it would if the stent struts and space there between were opaque. Figure 8B shows all stent struts from both the front and rear halves. The stent appears as it would if the stent struts and the space there between were transparent.

A first variation of a fifth embodiment of the present invention, shown in Figure 8C consists of a stent 10 with twelve expansion columns 24, four reinforcement expansion columns 86, and fifteen connecting strut columns 26. In this variation, the stent 10 has a length 16 of 31.96 mm, and an unexpanded circumference 88 of 5.26 mm.

Connecting struts 38 shown in an enlarged view in Figure 8G are made up of four linear sections, a proximal end section 162, first and second intermediate sections 164 and 166 respectively and a distal end section 168 forming three slant angles 170, 172 and 174. The proximal end of proximal section 162 is attached to a corner 176 of an expansion strut pair 32 of an expansion column 24. Corner 176 is formed where joining strut 30 makes narrow angle 48 with expansion strut 28. A second corner 178 of expansion strut 32 is formed where joining strut 30 makes wide angle 50 with expansion strut 28. Corners 176 and 178 can have an angular shape formed by joining linear expansion struts 28 and joining struts 30, or preferably corners 176 and 178 are rounded to remove sharp edges and provide increased flexibility. Additionally rounded corners provide stent 10 with greater expandability and reduce stress in the stent strut material at the corners in the expanded stent.

Proximal end section 162 of connecting strut 38 extends from corner 176 and is attached at its distal end to first intermediate section 164 forming slant angle 170. First intermediate section 164 extends from proximal end section 162 such that first intermediate section 164 is parallel to expansion

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struts 28 and is connected at its distal end to the proximal end of second intermediate section 166 forming slant angle 172.

Second intermediate section 166 extends in a slanted orientation relative to the longitudinal axis of stent 10, extending both longitudinally along and circumferentially about stent 10. Preferably, second intermediate section 166 is parallel to joining strut 30 of the circumferentially offset expansion strut pair 32 in adjacent expansion column 24.

Second intermediate section 166 attaches at its distal end to the proximal end of distal end section 168 forming slant angle 174. Distal end section 168 extends from second intermediate section 166 attaching at its distal end to joining strut 30 of circumferentially offset expansion strut pair 32 of adjacent expansion column 24. The attachment is at a point intermediate corners 176 and 178, where joining strut 30 forms narrow angle 48 and wide angle 50 respectively with expansion struts 28.

The connection point of distal end section 168 to joining strut 30 is closer to corner 176 than corner 178. Preferably the connection point is one to two or more expansion strut widths from corner 176. Offsetting the connection point of distal end section 168 to joining strut 30 from corner 176 to a point intermediate corner 176 and corner 178 reduces warping of the expanded stent 10, resulting in a smooth surface modulation and reduced risk of thrombosis. Additionally, this design provides a longer total straightened length of connecting strut 38, which further reduces foreshortening of stent 10 during expansion.

A second variation of a fifth embodiment of the present invention, shown in an unexpanded form in Figures 8D, 8E and in an expanded form in Figure 8F consists of a stent 10 with six expansion columns 24; two reenforcement expansion columns 86, and seven connecting strut columns 26. In this variation, the stent 10 has a length 16 of 15.04 mm, and an unexpanded circumference 88 of 5.26 mm. The stent design 10 is substantially similar to the design of the first variation of the fifth embodiment of Figure 8C with a

reduced number of expansion columns, reinforcement expansion columns, and connecting strut columns.

Figure 8F illustrates a portion of the expanded stent 10 of the second variation of the fifth embodiment. After expansion of stent 10 by balloon or other means, the expansion struts 28 are spread apart circumferentially, increasing the separation at the open end 36 of expansion strut pairs 32 resulting in an increase in the circumference of the stent 10. The spreading of the expansion struts 28 causes a longitudinal shortening of the expansion columns 24, which is compensated by a straightening of the connecting struts 38. During the expansion process, the slant angles 170, 172 and 174 widen straightening the connection struts 38, and causing an increase in the separation distance between adjacent expansion columns 24. The asymmetrical interlocking cell geometry of the expanded stent is illustrated in Figure 8F.

Figures 9A, 9B, 9C, 9D, 9E, 9F and 9G illustrate a sixth embodiment of the stent of the present invention. In this embodiment a three piece slanted connecting strut 38 is used to couple the joining strut 30 of an expansion strut pair 32 in one expansion column 24 to the joining strut 30 of a circumferentially offset expansion strut pair 32 in an adjacent expansion column 24. The joints between segments of connecting strut 38 are curved forming a smooth rounded shape. The expansion struts 28, joining struts 30, expansion columns 24, reinforcement expansion struts 90, reinforcement joining struts 96, and reinforcement expansion columns 86 are substantially similar to the fourth embodiment of Figure 8A. Connecting struts 38 in connecting strut columns 26, however, have an altered geometry and connectivity, described in more detail below.

A first variation of a sixth embodiment of the present invention, shown in Figure 9A, 9B and 9C consists of a stent 10 with eight expansion columns 24, three reinforcement expansion columns 86, and ten connecting strut columns 26. In this variation, the stent 10 has a length 16 of 20.32 mm.

Relief notches 204 are utilized at the joints between reinforcement expansion struts 90 and reinforcement joining struts 96 in the reinforcement

expansion columns 86 at the stent proximal end 12 and distal end 14. Relief notches 204 reduce the width of the joints between reinforcement expansion struts 90 and reinforcement joining struts 96, which reduces stress in the metal at the joints during and after expansion of the stent. Relief notches 204 are particularly important at the stent ends since the stent ends are especially susceptible to warping during and after expansion. Preferably relief notches 204 reduce the joint widths, such that the joint widths are substantially the same as the thickness of stent wall 46 (see Figures 1B and 1C).

Connecting struts 38 shown in an enlarged view in Figure 9D are made up of three linear sections, a proximal end section 194, an intermediate section 196 and a distal end section 198 forming two slant angles 200, 202. The connecting struts 38 have wide radii of curvature at the joints between connecting strut sections 194, 196 and 198. The shape of connecting strut 38 is thus curved or wavy rather than jagged and angular. The slant angles 200 and 202 are defined by linearly extrapolating proximal end section 194, intermediate section 196 and distal end section 198, as shown by the dotted lines in Figure 9D.

Figure 9E shows a variation of the connecting strut design of the sixth embodiment of the present invention. The connecting strut 38 of Figure 9E has smaller radii of curvature at the joints between proximal end section 194, intermediate section 196 and distal end section 198. Connecting strut 38 of Figure 9E is thus more jagged and angular than that of Figure 9D.

Referring to the connecting struts 38 of Figure 9D and 9E, the proximal end of proximal section 194 is attached to joining strut 30 of expansion strut pair 32 intermediate corners 176 and 178. Proximal end section 194 of connecting strut 38 extends from joining strut 30 and is attached at its distal end to intermediate section 196 forming slant angle 200. Intermediate section 196 extends from proximal end section 194 in a slanted orientation relative to the longitudinal axis of stent 10, extending both longitudinally along and circumferentially about stent 10. Intermediate section 196 is preferably parallel to joining struts 30 of coupled expansion strut pairs 32.

Intermediate section 196 is connected at its distal end to the proximal end of distal end section 198 forming slant angle 202. Distal end section 198 extends from second intermediate section 196 attaching at its distal end to joining strut 30 of circumferentially offset expansion strut pair 32 of adjacent expansion column 24. The attachment is at a point intermediate corners 176 and 178, where joining strut 30 forms narrow angle 48 and wide angle 50 respectively with expansion struts 28.

The connection point of proximal end section 194 and distal end section 198 to joining struts 30 is closer to corner 176 than corner 178. Preferably the connection point is one to two or more expansion strut widths from corner 176. Offsetting the connection point of distal end section 198 to joining strut 30 from corner 176 to a point intermediate corner 176 and corner 178 reduces warping of the expanded stent 10, resulting in a smooth surface modulation and reduced risk of thrombosis. Additionally, this design provides a longer total straightened length of connecting strut 38, which further reduces foreshortening of stent 10 during expansion.

The connecting strut 38 of the sixth embodiment has one hundred and eighty degree rotational symmetry about its center. The symmetry of the connecting strut 38 does not, however, result in a symmetrical cell space as the width of loop slots 42 connected in each cell space are different. Adjacent loop slots 42 in each expansion column have alternating narrow and wide widths, preserving the asymmetry of the cell spaces. Introduction of one or many symmetrical cell spaces can be achieved in this design e.g. by providing uniform loop slot width to loop slots in adjacent expansion columns 24 contained in the same cell space. Additionally completely non-uniform cell space patterns utilizing symmetric or asymmetric cell spaces can be achieved e.g. by providing non-uniform variations in the widths of loop slots 42.

A second variation of a sixth embodiment of the present invention, shown in an unexpanded form in Figures 9F consists of a stent 10 with six expansion columns 24, three reinforcement expansion columns 86, and eight connecting strut columns 26. In this variation, the stent 10 has a length 16 of

16.00 mm, and an unexpanded circumference 88 of 5.26 mm. The stent design 10 is substantially similar to the design of the first variation of the sixth embodiment of Figures 9A, 9B and 9C with a reduced number of expansion columns 24 and connecting strut columns 26.

A third variation of a sixth embodiment of the present invention, shown in an unexpanded form in Figures 9F consists of a stent 10 with twelve expansion columns 24, four reinforcement expansion columns 86, and fifteen connecting strut columns 26. In this variation, the stent 10 has a length 16 of 30.01 mm, and an unexpanded circumference 88 of 5.26 mm. The stent design 10 is substantially similar to the design of the first variation of the sixth embodiment of Figures 9A, 9B and 9C with an increased number of expansion columns 24 reinforcement expansion columns 86 and connecting strut columns 26.

Figures 10A, 10B, 10C, 10D, 10E and 10F illustrate some examples of alternate connecting strut designs which can be used in any of the previously discussed embodiments. Figure 10A shows a rounded loop connecting strut 38 which joins two circumferentially offset expansion strut pairs 32 in adjacent expansion columns. Expansion struts 28 in each expansion strut pair 32 are joined by a joining strut 30. Joining struts 30 are slanted such as to form a narrow angle 48 and a wide angle 50 with the expansion struts 28 they connect. The rounded loop connecting strut 38 connects expansion struts 28 at the point where narrow angle 48 is formed between expansion struts 28 and joining struts 30. The slopes of the rounded connecting strut 38 at its proximal end 102 and distal end 104 substantially match the slopes of the joining struts 30 connecting the pairs of expansion struts 28. The rounded loop connecting strut 38 thus blends smoothly into the joining struts 30. Additionally the rounded loop connecting strut 38 has a first radius of curvature 106 and a second radius of curvature 108.

In the design of Figure 10B a rounded loop connecting strut 38 joins two circumferentially offset expansion strut pairs 32 in adjacent expansion columns. Expansion struts 28 in each expansion strut pair 32 are joined by a

joining strut 30. Joining struts 30 are at right angles to the expansion struts 28 they connect. The rounded loop connecting strut 38 connects to expansion struts 28 at the same point as joining struts 30. The rounded connecting strut 38 has a first radius of curvature 106 and a second radius of curvature 108 such that it connects circumferentially offset expansion strut pairs 32.

In the design of Figure 10C connecting strut 38 joins two circumferentially offset expansion strut pairs 32 in adjacent expansion columns. Expansion struts 28 in each expansion strut pair 32 are joined by a joining strut 30. Joining struts 30 are slanted such as to form a narrow angle 48 and a wide angle 50 with the expansion struts 28 they connect. The connecting strut 38 connects expansion struts 28 at the point where narrow angle 48 is formed between expansion strut 28 and joining strut 30.

The connecting strut 38 is made up of three linear sections 110, 112, and 114 forming two slant angles 116 and 118. The proximal end of section 110 is attached to expansion strut 28 at the point where joining strut 30 forms narrow angle 48 with expansion strut 28. Section 110 extends substantially collinear to joining strut 30 and is attached at its distal end to intermediate section 112 forming slant angle 116. Intermediate section 112 extends at an angle to section 110 such that intermediate section 112 is substantially parallel to expansion struts 28 and is connected at its distal end to the proximal end of distal section 114 forming slant angle 118. Distal section 114 extends at an angle such that it is substantially collinear to joining strut 30 of the adjacent expansion strut pair 32. Distal section 114 attaches at its distal end to expansion strut 28 of the adjacent expansion strut pair 32, at the point where joining strut 30 forms narrow angle 48 with expansion strut 28.

In the design of Figures 10D and 10E a connecting strut 38 joins two circumferentially offset expansion strut pairs 32 in adjacent expansion columns. Expansion struts 28 in each expansion strut pair 32 are joined by a joining strut 30. Joining struts 30 are at right angles to the expansion struts 28 they connect. The connecting strut 38 connects to expansion struts 28 at the same point as joining struts 30.

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The connecting struts 38 of Figures 10D and 10E are made up of multiple connecting strut sections connected end to end to form a jagged connecting strut 38 with multiple slant angles, coupling expansion strut pair 32 to adjacent expansion strut pair 32. The connecting strut of Figure 10D is made up of three connecting strut sections, a proximal section 120, an intermediate section 122 and a distal section 124 defining two slant angles 126 and 128, while the connecting strut of Figure 10E consists of four connecting strut sections, a proximal section 130, intermediate sections 132 and 134, and a distal section 136 defining three slant angles 138, 140 and 142. In addition, connecting strut section 134 can be modified by replacing connecting strut section 136 by the dotted connecting strut section 144 to give another possible geometry of connecting struts 38.

In the design of Figures 10F connecting strut 38 joins two circumferentially offset expansion strut pairs 32 in adjacent expansion columns. Expansion struts 28 in each expansion strut pair 32 are joined by a joining strut 30. Joining struts 30 are slanted such as to form a narrow angle 48 and a wide angle 50 with the expansion struts 28 they connect.

Connecting strut 38 is made up of four linear sections, a proximal end section 180, first and second intermediate sections 182 and 184 respectively and a distal end section 186 forming three slant angles 188, 190 and 192. The proximal end of section 180 is attached to corner 176 at the point where joining strut 30 forms narrow angle 48 with expansion strut 28. Proximal end section 180 extends at an angle to joining strut 30 and is attached at its distal end to first intermediate section 182 forming slant angle 188. First intermediate section 182 extends at an angle to proximal end section 180 such that first intermediate section 182 is substantially parallel to expansion struts 28 and is connected at its distal end to the proximal end of second intermediate section 184 forming slant angle 190. Second intermediate section 184 is substantially longer than the first intermediate section 182. Second intermediate section 184 extends at an angle such that it is substantially collinear to joining strut 30 of the adjacent expansion strut pair 32. Second intermediate section 184 attaches

at its distal end to the proximal end of distal end section 186 forming slant angle 192. Distal end section 186 extends in a slightly sloping orientation relative to expansion struts 28, attaching to corner 176 of expansion strut pair 32 where joining strut 30 forms narrow angle 48 with expansion strut 28. Relief notches 206 are formed at the joint between distal end segment 186 of connecting strut 38 and corner 176 of expansion strut pair 32 to increase flexibility of the unexpanded stent and prevent warping when the stent is expanded.

One skilled in the art will recognize that there are many possible arrangements of connecting struts and joining struts consistent with the present invention; the above examples are not intended to be an exhaustive list. In particular, it is noted that (a) connecting strut sections need not be linear but may contain one or many radii of curvature, (b) connecting strut sections may each have a different longitudinal axis, (c) the joint between connecting strut sections need not be jagged or sharp, but rather can be smooth containing one or multiple radii of curvature, and (d) relief notches may be present at any of the strut joints.

The stent of the present invention is ideally suited for application in coronary vessels although versatility in the stent design allows for applications in non-coronary vessels, the aorta, and nonvascular tubular body organs.

Typical coronary vascular stents have expanded diameters that range from 2.5 to 5.0 mm. However, a stent with high radial strength and fatigue tolerance that expands to a 5.0 mm diameter may have unacceptably high stent metal fraction when used in smaller diameter vessels. If the stent metal fraction is high, the chances of acute thrombosis and restenosis potential will increase. Even with the same metal fraction a smaller caliber vessel is more likely than a larger one to have a high rate of thrombosis. It is, therefore, preferred to have at least two different categories of stents for coronary application, for example, small vessels stents for use in vessels with diameters from 2.5 mm to 3.0 mm, and large vessel stents for use in vessels with diameters from 3.0 mm to 5.0

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mm. Thus, both small vessels and large vessels when treated with the appropriate sized stent will contain stents of similar idealized metal fraction.

The stent of the present invention can be made using a CAM-driven laser cutting system to cut the stent pattern from a stainless steel tube. The rough-cut stent is preferably electro-polished to remove surface imperfections and sharp edges. Other methods of fabricating the stent can also be used such as EDM, photo-electric etching technology, or other methods. Any suitable material can be used for the stent including other metals and polymers so long as they provide the essential structural strength, flexibility, biocompatibility and expandability.

The stent is typically at least partially plated with a radiopaque metal, such as gold, platinum, tantalum or other suitable metal. It is preferred to plate only both ends of the stent by localized plating; however, the entire stent or other regions can also be plated. When plating both ends, one to three or more expansion columns on each end of the stent are plated to mark the ends of the stent so they can be identified under fluoroscopy during the stenting procedure. By plating the stent only at the ends, interference of the radiopaque plating material with performance characteristics or surface modulation of the stent frame is minimized. Additionally the amount of plating material required is reduced, lowering the material cost of the stent.

After plating, the stent is cleaned, typically with detergent, saline and ultrasonic means that are well-known in the art. The stents are then inspected for quality control, assembled with the delivery balloon catheter, and properly packaged, labeled, and sterilized.

Stent 10 can be marketed as stand alone or as a pre-mounted delivery balloon catheter assembly as shown in Figure 11. Referring to Figure 11, the stent 10 is crimped over a folded balloon 146 at the distal end 148 of a delivery balloon catheter assembly 150. The assembly 150 includes a proximal end adapter 152, a catheter shaft 154, a balloon channel 156, a guidewire channel 158, a balloon 146, and a guidewire 160. Balloon 146 can be tapered, curved, or both tapered and curved from a proximal end to a distal end in the expanded

state. Additionally stent 10 can be non-tapered or tapered in the expanded state.

Typically the guidewire 160 is inserted into the vein or artery and advanced to the target site. The catheter shaft 154 is then forwarded over the guidewire 160 to position the stent 10 and balloon 146 into position at the target site. Once in position the balloon 146 is inflated through the balloon channel 156 to expand the stent 10 from a crimped to an expanded state. In the expanded state, the stent 10 provides the desired scaffolding support to the vessel. Once the stent 10 has been expanded, the balloon 146 is deflated and the catheter shaft 154, balloon 146, and guidewire 160 are withdrawn from the patient.

The stent of the present invention can be made as short as less than 10 mm in length or as long as 100 mm or more. If long stents are to be used, however, matching length or preferably slightly longer delivery catheter balloons will typically be needed to expand the stents into their deployed positions. Long stents, depending on the target vessel, may require curved long balloons, tapered long balloons or curved and tapered long balloons for deployment. Curved and/or tapered balloons which match the natural curve and taper of a blood vessel reduce stress on the blood vessel during and after stent deployment. This is especially important in many coronary applications which involve stenting in curved and tapered coronary vessels. The use of such curved and/or tapered balloons is within the scope of the present invention.

The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in this art. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

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CLAIMS

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- 1 A stent in a non-expanded state, comprising:
 - 2 a first expansion strut pair including a first expansion strut positioned
 - 3 adjacent to a second expansion strut and a joining strut of the first expansion
 - 4 strut pair that couples the first and second expansion struts at a distal end of the
 - 5 first expansion strut pair, a plurality of the first expansion strut pair forming a
 - 6 first expansion column;
 - 7 a second expansion strut pair including a first expansion strut positioned
 - 8 adjacent to a second expansion strut and a joining strut of the second
 - 9 expansion strut pair that couples the first and second expansion struts of the
 - 10 second expansion strut pair at a proximal end of the second expansion strut
 - 11 pair, a plurality of the second expansion strut pair forming a second expansion
 - 12 column;
 - 13 a first connecting strut including a first connecting strut proximal
 - 14 section, a first connecting strut distal section and a first connecting strut
 - 15 intermediate section, the first connecting strut proximal section being coupled
 - 16 to the distal end of the first expansion strut pair in the first expansion column
 - 17 and the first connecting strut distal section being coupled to the proximal end of
 - 18 the second expansion strut pair of the second expansion column, a plurality of
 - 19 the first connecting strut forming a first connecting strut column that couples
 - 20 the first expansion column to the second expansion column, wherein a length of
 - 21 the first connecting strut proximal section is equal to a length of the first
 - 22 connecting strut distal section, and a length of the first connecting strut
 - 23 intermediate section is greater than the length of the first connecting strut
 - 24 proximal and distal sections.
- 1 2. The stent of claim 1, wherein the first expansion strut of the first
 - 2 expansion strut pair in the first expansion column has a longitudinal axis offset
 - 3 from a longitudinal axis of the first expansion strut of the second expansion
 - 4 strut pair in the second expansion column.

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1 3. The stent of claim 1, wherein a spacing distance between the
2 first expansion column strut pair and an adjacent first expansion column strut
3 pair in the first expansion column are the same.

1 4. The stent of claim 1, wherein a spacing distance between the
2 second column expansion strut pair and an adjacent second column expansion
3 strut pair in the second expansion column are different.

1 5. The stent of claim 1, wherein a spacing distance between the
2 first expansion column strut pair and an adjacent first expansion column strut
3 pair in the first expansion column, and a spacing distance between the second
4 column expansion strut pair and an adjacent second column expansion strut
5 pair in the second expansion column are the same.

1 6. The stent of claim 1, wherein a spacing distance between the
2 first expansion column strut pair and an adjacent first expansion column strut
3 pair in the first expansion column, and a spacing distance between the second
4 column expansion strut pair and an adjacent second column expansion strut
5 pair in the second expansion column are different.

1 6 7. The stent of claim 1, wherein a first radius of curvature is
2 formed where the first connecting strut proximal section is coupled to the first
3 connecting strut intermediate section.

1 7 8. The stent of claim 1, wherein a second radius of curvature is
2 formed where the first connecting strut distal section is coupled to the first
3 connecting strut intermediate section.

1 8 9. The stent of claim 1, wherein a first radius of curvature is
2 formed where the first connecting strut proximal section is coupled to the first
3 connecting strut intermediate section and a second radius of curvature is formed

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4 where the first connecting strut distal section is coupled to the first connecting
5 strut intermediate section.

1 9 10. The stent of claim 1, wherein a first slant angle is formed where
2 the first connecting strut proximal section is coupled to the first connecting
3 strut intermediate section.

1 10 11. The stent of claim 1, wherein a second slant angle is formed
2 where the first connecting strut distal section is coupled to the first connecting
3 strut intermediate section.

1 11 12. The stent of claim 1, wherein a first slant angle is formed where
2 the first connecting strut proximal section is coupled to the first connecting
3 strut intermediate section and a second slant angle is formed where the first
4 connecting strut distal section is coupled to the first connecting strut
5 intermediate section.

1 12 13. The stent of claim 1, wherein the stent further includes a
2 radiopaque marker.

1 13 14. The stent of claim 1, wherein the stent includes an electroplated
2 material for radiopaque observation under fluoroscopy.

1 14 15. The stent of claim 1, wherein a proximal end and a distal end of
2 the stent are at least partially radiopaque electroplated.

1 15 16. The stent of claim 1, wherein a ratio of a number of expansion
2 struts in an expansion strut column to a number of connecting struts in a
3 connecting strut column is 2 to 1.

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1 ~~16~~ 17. The stent of claim 1, wherein the stent includes m first and
 2 second expansion columns, n expansion struts per column and $n(m-1)/2$
 3 connecting struts.

1 ~~17~~ 18. The stent of claim 1, wherein the first and second expansion
 2 columns are each unbroken, continuous structures.

1 ~~18~~ 19. The stent of claim 1, further comprising:
 2 a reinforcement expansion column made of a plurality of reinforcement
 3 expansion struts, wherein each reinforcement expansion strut has a width that
 4 is greater than a width of an expansion strut in the first or second expansion
 5 columns.

1 ~~19~~ 20. The stent of claim ~~19~~ 18, wherein the reinforcement expansion
 2 column includes a plurality of relief notches.

1 ~~20~~ 21. The stent of claim 1, wherein the stent has a proximal end with a
 2 first reinforcement expansion column and a distal end with a second
 3 reinforcement expansion column.

1 ~~21~~ 22. The stent of claim ~~21~~ 20, wherein the first and second
 2 reinforcement expansion columns each include a plurality of relief notches.

1 ~~22~~ 23. The stent of claim ~~22~~ 20, further comprising:
 2 a third reinforcement expansion column intermediate the stent proximal
 3 end and the stent distal end.

1 24. A stent in a non-expanded state, comprising:
 2 a first expansion column formed of a plurality of first expansion column
 3 strut pairs, a first expansion strut pair including a first expansion strut adjacent
 4 to a second expansion strut and a first joining strut that couples the first and

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5 second expansion struts at a proximal end of the first expansion strut pair, a
 6 second expansion strut pair including a third expansion strut adjacent to the
 7 second expansion strut and a second joining strut that couples the second and
 8 third expansion struts at a distal end of the second expansion strut pair, a third
 9 expansion strut pair including a fourth expansion strut adjacent to the third
 10 expansion strut and a third joining strut that couples the third and fourth
 11 expansion struts at a proximal end of the third expansion strut pair, a fourth
 12 expansion strut pair including a fifth expansion strut adjacent to the fourth
 13 expansion strut and a fourth joining strut that couples the fourth and fifth
 14 expansion struts at a distal end of the fourth expansion strut pair, a first
 15 expansion strut pair first corner formed where the first joining strut is coupled
 16 to the first expansion strut, and a first expansion strut pair second corner
 17 formed where the first joining strut is coupled to the second expansion strut,
 18 and a second expansion strut pair first corner formed where the second joining
 19 strut is coupled to the second expansion strut, and a second expansion strut pair
 20 second corner formed where the second joining strut is coupled to the third
 21 expansion strut, and a third expansion strut pair first corner formed where the
 22 third joining strut is coupled to the third expansion strut, and a third expansion
 23 strut pair second corner formed where the third joining strut is coupled to the
 24 fourth expansion strut, and a fourth expansion strut pair first corner formed
 25 where the fourth joining strut is coupled to the fourth expansion strut, and a
 26 fourth expansion strut pair second corner formed where the fourth joining strut
 27 is coupled to the fifth expansion strut;
 28 a second expansion column formed of a plurality of second expansion
 29 column strut pairs, a first expansion strut pair including a first expansion strut
 30 adjacent to a second expansion strut and a first joining strut that couples the
 31 first and second expansion struts at a proximal end of the first expansion strut
 32 pair, a second expansion strut pair including a third expansion strut adjacent to
 33 the second expansion strut and a second joining strut that couples the second
 34 and third expansion struts at a distal end of the second expansion strut pair, a
 35 third expansion strut pair including a fourth expansion strut adjacent to the

36 third expansion strut and a third joining strut that couples the third and fourth
 37 expansion struts at a proximal end of the third expansion strut pair, a fourth
 38 expansion strut pair including a fifth expansion strut adjacent to the fourth
 39 expansion strut and a fourth joining strut that couples the fourth and fifth
 40 expansion struts at a distal end of the fourth expansion strut pair, a first
 41 expansion strut pair first corner formed where the first joining strut is coupled
 42 to the first expansion strut, and a first expansion strut pair second corner
 43 formed where the first joining strut is coupled to the second expansion strut,
 44 and a second expansion strut pair first corner formed where the second joining
 45 strut is coupled to the second expansion strut, and a second expansion strut pair
 46 second corner formed where the second joining strut is coupled to the third
 47 expansion strut, and a third expansion strut pair first corner formed where the
 48 third joining strut is coupled to the third expansion strut, and a third expansion
 49 strut pair second corner formed where the third joining strut is coupled to the
 50 fourth expansion strut, and a fourth expansion strut pair first corner formed
 51 where the fourth joining strut is coupled to the fourth expansion strut, and a
 52 fourth expansion strut pair second corner formed where the fourth joining strut
 53 is coupled to the fifth expansion strut; and
 54 a first connecting strut column formed of a plurality of first connecting
 55 struts, each connecting strut of the first connecting strut column including a
 56 connecting strut proximal section, a connecting strut distal section and a
 57 connecting strut intermediate section, a first connecting strut proximal section
 58 is coupled to the joining strut of the second expansion strut pair of the first
 59 expansion strut column, and a first connecting strut distal section is coupled to
 60 the joining strut of the first expansion strut pair of the second expansion strut
 61 column, and a second connecting strut proximal section is coupled to the
 62 joining strut of the fourth expansion strut pair of the first expansion strut
 63 column, and a second connecting strut distal section is coupled to the joining
 64 strut of the third expansion strut pair of the second expansion strut column,
 65 wherein a length of the connecting strut proximal section is the same as a
 66 length of the connecting strut distal section and the connecting strut

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67 intermediate section has a length that is greater than the lengths of the
68 connecting strut distal and proximal sections.

1 24/25. The stent of claim 24, wherein the stent includes a proximal
2 expansion column, a distal expansion column, a plurality of connecting struts
3 positioned between the proximal and distal expansion columns, and a plurality
4 of expansion columns positioned between the proximal and distal expansion
5 columns, each expansion column being made of a plurality of juxtapositioned
6 proximal and distal looped slots.

1 25/26. The stent of claim 24, wherein the first expansion column, the
2 second expansion column, and the first connecting strut column form a
3 plurality of geometric cells.

1 26/27. The stent of claim 26, wherein at least a portion of the plurality
2 are asymmetrical geometric cells.

1 27/28. The stent of claim 24, wherein the first expansion column, the
2 second expansion column, and the first connecting strut column form a
3 plurality of cells and at least a portion of the plurality of cells form non-uniform
4 cell space patterns.

1 28/29. The stent of claim 24, wherein the first expansion strut column,
2 the second expansion strut column and the first connecting strut column form a
3 plurality of geometric configurations and at least a portion of the plurality form
4 asymmetrical geometric configurations.

1 29/30. The stent of claim 24, wherein the first expansion strut column,
2 the second expansion strut column and the first connecting strut column form a
3 plurality of geometric configurations and at least a portion of the plurality form
4 symmetrical geometric configurations.

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30 31. The stent of claim 24, wherein the first connecting strut proximal section is coupled to the joining strut of the second expansion strut pair of the first expansion strut column, and the first connecting strut distal section is coupled to the first corner of the first expansion strut pair of the second expansion strut column, and the second connecting strut proximal section is coupled to the joining strut of the fourth expansion strut pair of the first expansion strut column, and the second connecting strut distal section is coupled to the first corner of the third expansion strut pair of the second expansion strut column.

31 32. The stent of claim 24, wherein the first connecting strut proximal section is coupled to the joining strut of the second expansion strut pair of the first expansion strut column, and the first connecting strut distal section is coupled to the second corner of the first expansion strut pair of the second expansion strut column, and the second connecting strut proximal section is coupled to the joining strut of the fourth expansion strut pair of the first expansion strut column, and the second connecting strut distal section is coupled to the second corner of the third expansion strut pair of the second expansion strut column.

32 33. The stent of claim 24, wherein the first connecting strut proximal section is coupled to the first corner of the second expansion strut pair of the first expansion strut column, and the first connecting strut distal section is coupled to the joining strut of the first expansion strut pair of the second expansion strut column, and the second connecting strut proximal section is coupled to the first corner of the fourth expansion strut pair of the first expansion strut column, and the second connecting strut distal section is coupled to the joining strut of the third expansion strut pair of the second expansion strut column.

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33/ 34. The stent of claim 24, wherein the first connecting strut proximal section is coupled to the second corner of the second expansion strut pair of the first expansion strut column, and the first connecting strut distal section is coupled to the joining strut of the first expansion strut pair of the second expansion strut column, and the second connecting strut proximal section is coupled to the second corner of the fourth expansion strut pair of the first expansion strut column, and the second connecting strut distal section is coupled to the joining strut of the third expansion strut pair of the second expansion strut column.

34/ 35. The stent of claim 24, wherein the first connecting strut proximal section is coupled to the first corner of the second expansion strut pair of the first expansion strut column, and the first connecting strut distal section is coupled to the first corner of the first expansion strut pair of the second expansion strut column, and the second connecting strut proximal section is coupled to the first corner of the fourth expansion strut pair of the first expansion strut column, and the second connecting strut distal section is coupled to the first corner of the third expansion strut pair of the second expansion strut column.

35/ 36. The stent of claim 24, wherein the first connecting strut proximal section is coupled to the first corner of the second expansion strut pair of the first expansion strut column, and the first connecting strut distal section is coupled to the second corner of the first expansion strut pair of the second expansion strut column, and the second connecting strut proximal section is coupled to the first corner of the fourth expansion strut pair of the first expansion strut column, and the second connecting strut distal section is coupled to the second corner of the third expansion strut pair of the second expansion strut column.

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1 ²³ 34. The stent of claim 24, wherein the first connecting strut
 2 proximal section is coupled to the second corner of the second expansion strut
 3 pair of the first expansion strut column, and the first connecting strut distal
 4 section is coupled to the first corner of the first expansion strut pair of the
 5 second expansion strut column, and the second connecting strut proximal
 6 section is coupled to the second corner of the fourth expansion strut pair of the
 7 first expansion strut column, and the second connecting strut distal section is
 8 coupled to the first corner of the third expansion strut pair of the second
 9 expansion strut column.

1 ²³ 37. The stent of claim 24, wherein the first connecting strut
 2 proximal section is coupled to the second corner of the second expansion strut
 3 pair of the first expansion strut column, and the first connecting strut distal
 4 section is coupled to the second corner of the first expansion strut pair of the
 5 second expansion strut column, and the second connecting strut proximal
 6 section is coupled to the second corner of the fourth expansion strut pair of the
 7 first expansion strut column, and the second connecting strut distal section is
 8 coupled to the second corner of the third expansion strut pair of the second
 9 expansion strut column.

1 ²³ 38. The stent of claim 24, wherein the first column expansion strut
 2 pairs define first column loop slots, and the second column expansion strut
 3 pairs define second column loop slots.

1 ³⁴ 39. The stent of claim 39, wherein the first column loop slots are
 2 parallel to the second column loop slots.

1 ³⁸ 40. The stent of claim 39, wherein the first column loop slots are not
 2 parallel to the second column loop slots.

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- 1 41/ 42. The stent of claim 38, wherein the first column loop slots are
2 longitudinally offset from the second column loop slots.
- 1 42/ 43. The stent of claim 38, wherein the first column loop slots are
2 non-collinear to the second column loop slots.
- 1 43/ 44. The stent of claim 38, wherein the first column loop slots are
2 collinear with the second column loop slots.
- 1 44/ 45. The stent of claim 38, wherein a width of first column loop slots
2 is the same as a width of second column loop slots.
- 1 45/ 46. The stent of claim 38, wherein a width of the first column loop
2 slots is different than a width of the second column loop slots.
- 1 46/ 47. The stent of claim 38, wherein a shape of the first column loop
2 slots is different than a shape of the second column loop slots.
- 1 47/ 48. The stent of claim 38, wherein a shape of the first column loop
2 slots is the same as a shape of the second column loop slots.
- 1 48/ 49. The stent of claim 38, wherein a shape of a first column loop
2 slot of the first expansion column is different from a shape of an adjacent first
3 column loop slot of the first expansion column.
- 1 49/ 50. The stent of claim 38, wherein a shape of a first column loop
2 slot of the first expansion column is the same as a shape of an adjacent first
3 column loop slot of the first expansion column.

1 50/51. The stent of claim 38, wherein a width of a first column loop
2 slot of the first expansion column is different from a width of an adjacent first
3 column loop slot of the first expansion column.

1 51/52. The stent of claim 38, wherein a width of a first column loop
2 slot of the first expansion column is the same as a width of an adjacent first
3 column loop slot of the first expansion column.

1 52/53. The stent of claim 38, wherein each connecting strut proximal
2 section has a substantially linear geometry.

1 53/54. The stent of claim 38, wherein each connecting strut distal
2 section has a substantially linear geometry.

1 54/55. The stent of claim 38, wherein each connecting strut
2 intermediate section has a substantially linear geometry.

1 55/56. The stent of claim 38, wherein a ratio of a number of expansion
2 struts in an expansion strut column to a number of connecting struts in a
3 connecting strut column is 2 to 1.

1 56/57. The stent of claim 38, wherein the stent includes m first and
2 second expansion columns, n connecting struts per column and $n(n-1)/2$
3 connecting struts.

1 57/58. The stent of claim 38, wherein the first and second expansion
2 columns are each unbroken, continuous column structures.

1 58/59. The stent of claim 38, wherein one of the first or second
2 expansion column is a broken column structure.

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1 ²³ 59/60. The stent of claim 24, further comprising:
 2 a plurality of first expansion columns;
 3 a plurality of second expansion columns; and
 4 a plurality of first connecting strut columns, each first connecting strut
 5 column coupling a first expansion column to a second expansion column.

1 ⁵⁹ 60. The stent of claim 60, wherein a plurality of first expansion
 2 columns, second expansion columns and first connecting strut columns form a
 3 continuous a chain mesh strut frame pattern.

1 ⁵⁹ 61. The stent of claim 60, wherein the plurality of first expansion
 2 columns, the plurality of second expansion columns and the plurality of first
 3 connecting strut columns form an elongated structure.

1 ²³ 62. The stent of claim 24, further comprising:
 2 a reinforcement expansion column made of a plurality of reinforcement
 3 expansion struts, wherein each reinforcement expansion strut has a width that
 4 is greater than a width of an expansion strut in the first or second expansion
 5 columns.

1 ²³ 63. The stent of claim 24, wherein the stent has a proximal end with
 2 a first reinforcement expansion column and a distal end with a second
 3 reinforcement expansion column.

1 ²³ 64. The stent of claim 24, wherein the stent has a reinforcement
 2 expansion column between a proximal end and a distal end of the stent.

1 ²³ 65. The stent of claim 24, further comprising:
 2 a third expansion column formed of a plurality of third expansion
 3 column strut pairs, a first expansion strut pair including a first expansion strut
 4 adjacent to a second expansion strut and a first joining strut that couples the

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5 first and second expansion struts at a proximal end of the first expansion strut
6 pair, a second expansion strut pair including a third expansion strut adjacent to
7 the second expansion strut and a second joining strut that couples the second
8 and third expansion struts at a distal end of the second expansion strut pair, a
9 third expansion strut pair including a fourth expansion strut adjacent to the
10 third expansion strut and a third joining strut that couples the third and fourth
11 expansion struts at a proximal end of the third expansion strut pair, a fourth
12 expansion strut pair including a fifth expansion strut adjacent to the fourth
13 expansion strut and a fourth joining strut that couples the fourth and fifth
14 expansion struts at a distal end of the fourth expansion strut pair, a first
15 expansion strut pair first corner formed where the first joining strut is coupled
16 to the first expansion strut, and a first expansion strut pair second corner
17 formed where the first joining strut is coupled to the second expansion strut,
18 and a second expansion strut pair first corner formed where the second joining
19 strut is coupled to the second expansion strut, and a second expansion strut pair
20 second corner formed where the second joining strut is coupled to the third
21 expansion strut, and a third expansion strut pair first corner formed where the
22 third joining strut is coupled to the third expansion strut, and a third expansion
23 strut pair second corner formed where the third joining strut is coupled to the
24 fourth expansion strut, and a fourth expansion strut pair first corner formed
25 where the fourth joining strut is coupled to the fourth expansion strut, and a
26 fourth expansion strut pair second corner formed where the fourth joining strut
27 is coupled to the fifth expansion strut; and
28 a second connecting strut column formed of a plurality of second
29 connecting struts, each connecting strut of the second connecting strut column
30 including a connecting strut proximal section, a connecting strut distal section
31 and a connecting strut intermediate section, a first connecting strut proximal
32 section is coupled to the joining strut of the second expansion strut pair of the
33 second expansion strut column, and a first connecting strut distal section is
34 coupled to the joining strut of the first expansion strut pair of the third
35 expansion strut column, and a second connecting strut proximal section is

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36 coupled to the joining strut of the fourth expansion strut pair of the second
 37 expansion strut column, and a second connecting strut distal section is coupled
 38 to the joining strut of the third expansion strut pair of the third expansion strut
 39 column.

1 ~~66~~ 67. The stent of claim 66, wherein the first expansion strut of the
 2 first expansion strut pair in the second expansion column has a longitudinal
 3 axis offset from a longitudinal axis of the first expansion strut of the second
 4 expansion strut pair in the third expansion column.

1 ~~67~~ 68. The stent of claim 66, wherein the first expansion column, the
 2 second expansion column, and the first connecting strut column form a first
 3 plurality of geometric cells, and the second expansion column, the third
 4 expansion column and the second connecting strut column form a second
 5 plurality of geometric cells.

1 ~~68~~ 69. The stent of claim 68, wherein at least a portion of the first
 2 plurality of geometric cells and at least a portion of the second plurality of
 3 geometric cells form asymmetric cells.

1 ~~69~~ 70. The stent of claim 68, wherein at least a portion of the first
 2 plurality of geometric cells and at least a portion of the second plurality of
 3 geometric cells are symmetric cells.

1 ~~70~~ 71. The stent of claim 69, wherein each geometric cell of the first
 2 plurality includes a proximal looped slot and a distal looped slot, and each
 3 geometric cell of the second plurality includes a proximal looped slot and a
 4 distal looped slot.

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1 ⁷¹ 72. The stent of claim ⁷⁰ 71, wherein each distal looped slot of a cell of
 2 the first plurality is juxtapositioned to a corresponding proximal looped slot of
 3 a cell of the second plurality.

1 ⁷² 73. The stent of claim ⁶⁵ 72, wherein the stent includes a proximal
 2 expansion column, a distal expansion column, a plurality of connecting struts
 3 positioned between the proximal and distal expansion columns, and a plurality
 4 of expansion columns positioned between the proximal and distal expansion
 5 columns, each expansion column being made of a plurality of juxtapositioned
 6 proximal and distal looped slots.

1 ⁷³ 74. The stent of claim ²³ 73, wherein a width of the first connecting
 2 strut is equal to or less than a width of the first expansion strut of the first or
 3 second expansion columns.

1 ⁷⁴ 75. The stent of claim ²³ 74, wherein a width of a connecting strut of
 2 the first connecting strut column is larger than a width of a first expansion strut
 3 of the first or second expansion columns.

1 ⁷⁵ 76. The stent of claim ²⁷ 75, wherein a width of the second expansion
 2 strut of the first or second expansion columns is substantially the same as the
 3 width of the first expansion strut of the first or second expansion columns.

1 ⁷⁶ 77. The stent of claim ²³ 76, wherein the stent has a tapered diameter
 2 in an expanded state.

1 ⁷⁷ 78. The stent of claim ²³ 77, wherein the stent has a tapered geometry
 2 extending from a proximal end to a distal end in an expanded state.

1 ⁷⁸ 79. The stent of claim ²³ 78, wherein the stent is configured to be
 2 positioned at an exterior of an expandable balloon.

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1 ~~79~~ 80. The stent assembly of claim ~~79~~, wherein the balloon is curved
2 extending from a proximal end and a distal end in an expanded state.

1 ~~80~~ 81. The stent assembly of claim ~~80~~, wherein the balloon is tapered
2 in an expanded state and the stent has a non-tapered geometry in an expanded
3 state.

1 ~~81~~ 82. The stent assembly of claim ~~81~~, wherein the balloon and the
2 stent are both tapered in an expanded state.

1 ~~82~~ 83. The stent assembly of claim ~~82~~, wherein the stent is non-tapered
2 in an expanded state.

1 ~~83~~ 84. The stent assembly of claim ~~83~~, wherein the stent is tapered in
2 an expanded state.

1 ~~84~~ 85. The stent of claim ~~84~~, wherein the stent in an expanded state is
2 non-tapered, and the balloon is tapered and curved in an expanded state.

1 ~~85~~ 86. The stent of claim ~~85~~, wherein the stent is tapered in an
2 expanded state, and the balloon is tapered and curved in an expanded state.

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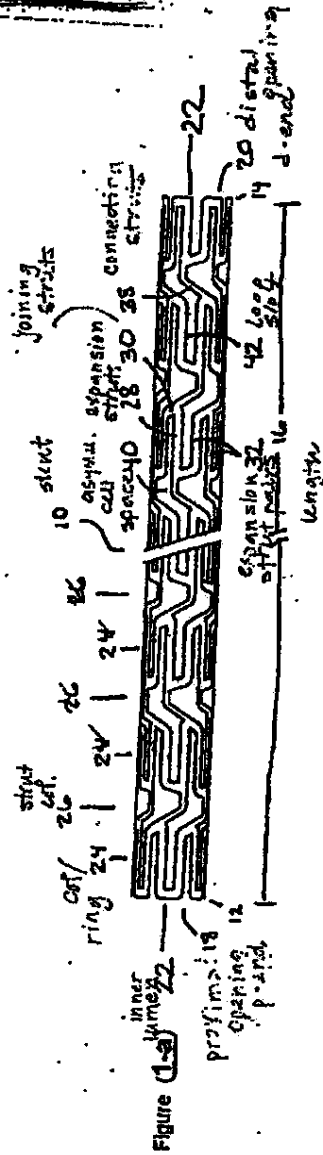


Figure 1-a

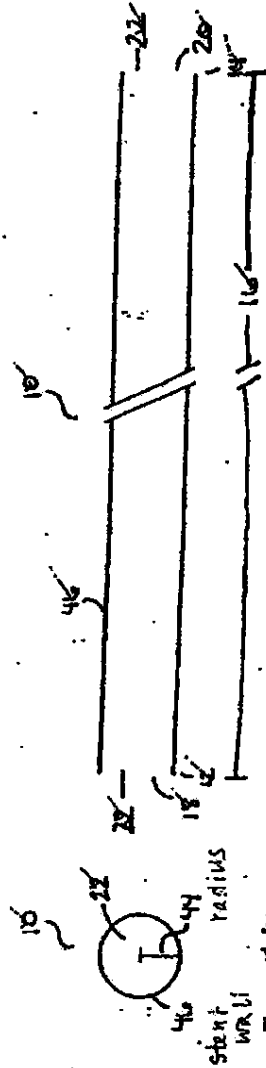


Figure 1-b

Figure 1-c

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1-28

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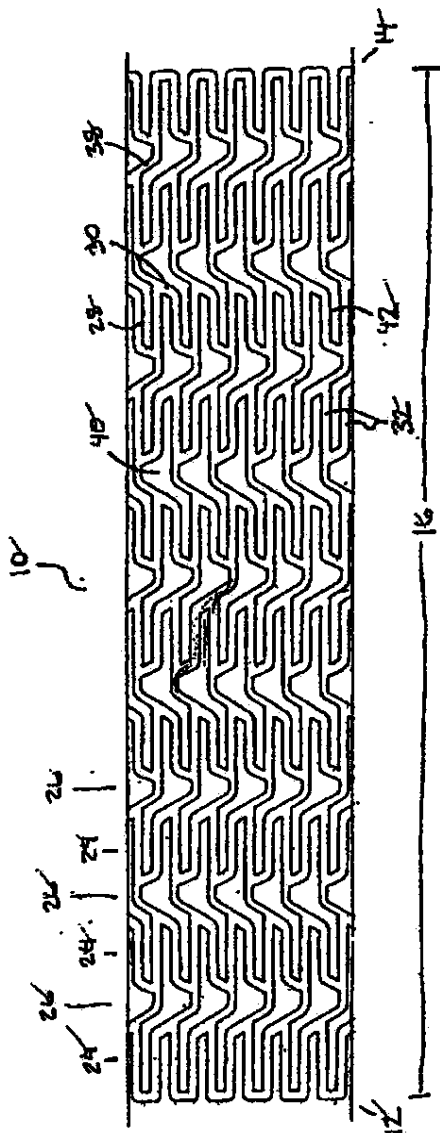
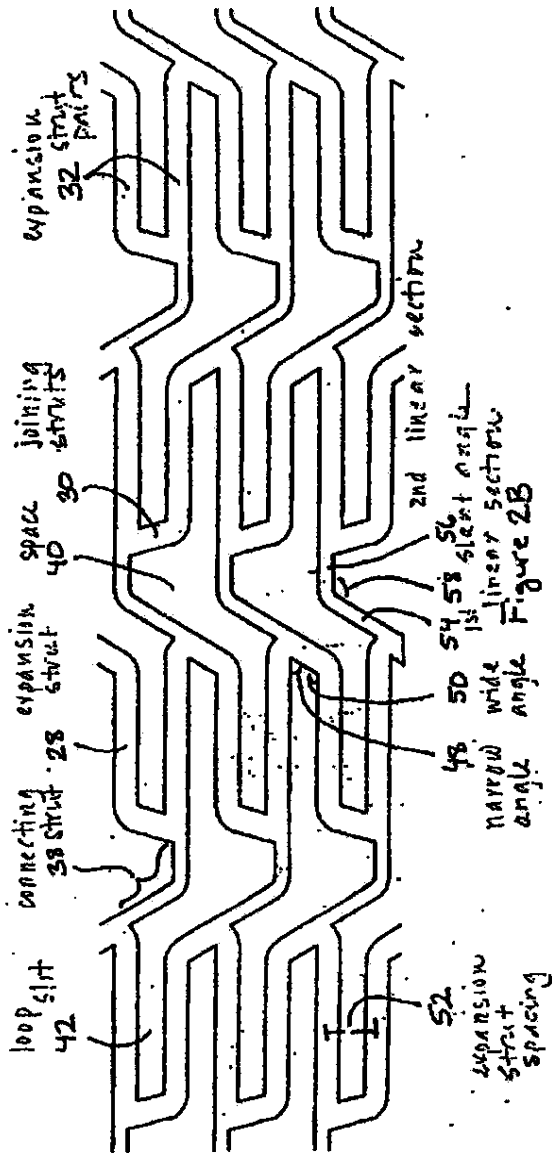


Figure 2A

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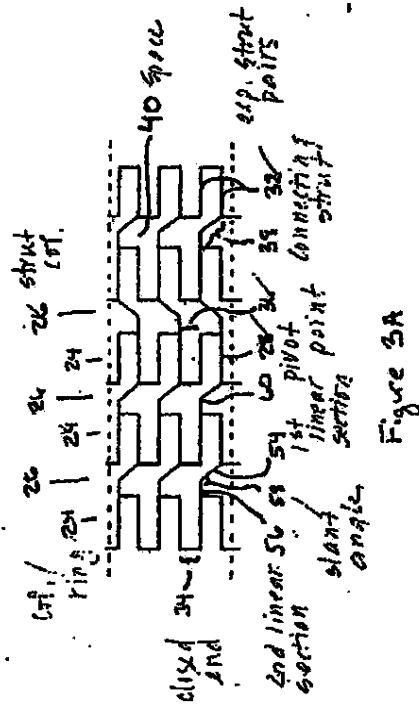


Figure 3A

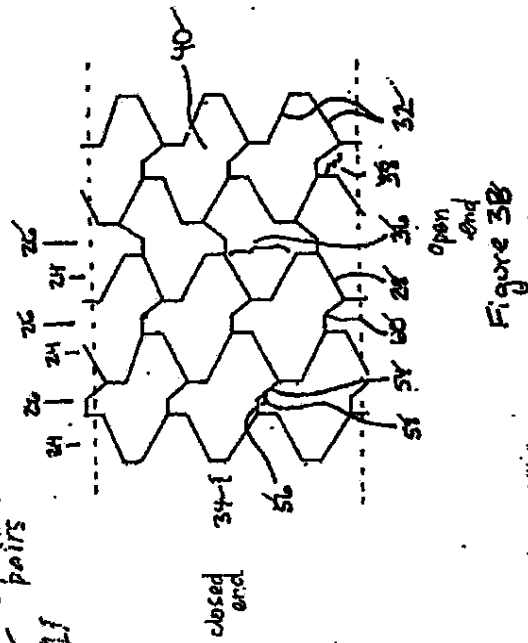
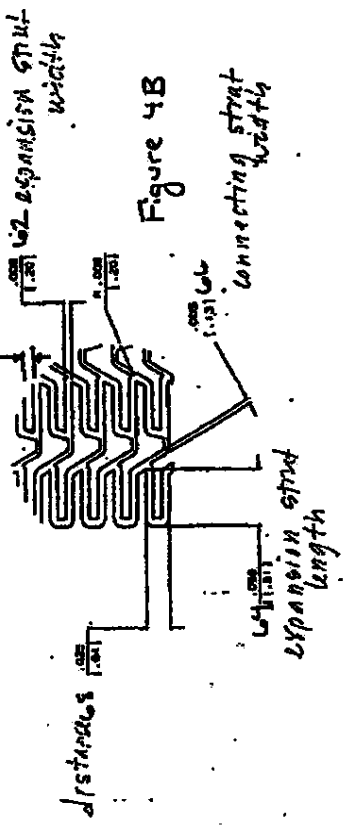
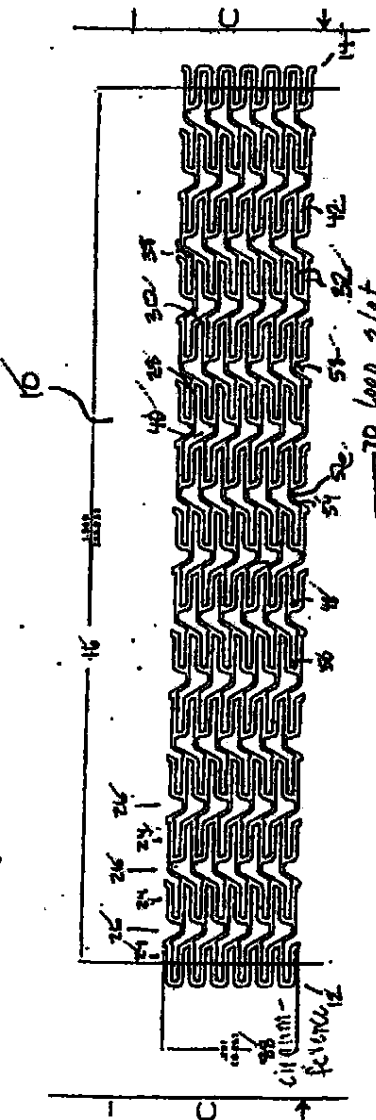


Figure 3B

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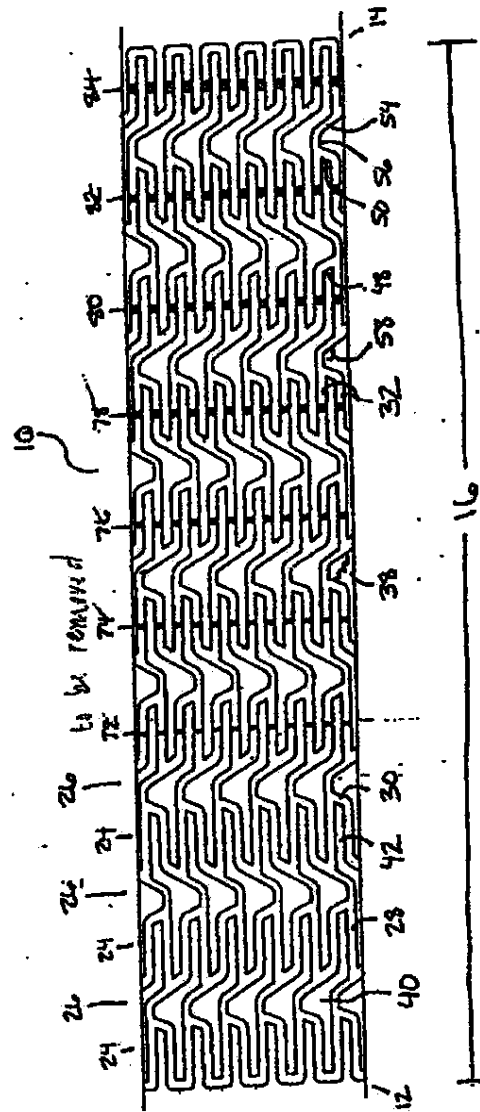
Figure 4A



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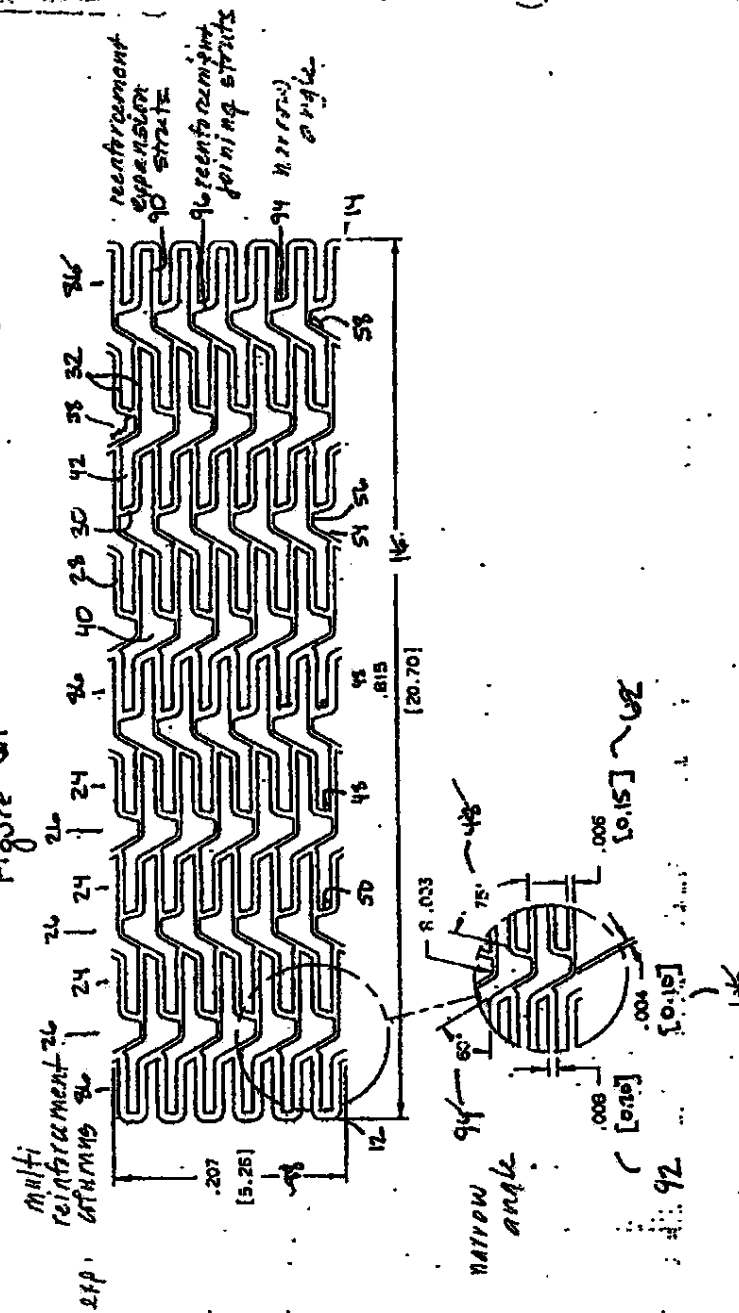
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Figure 5.



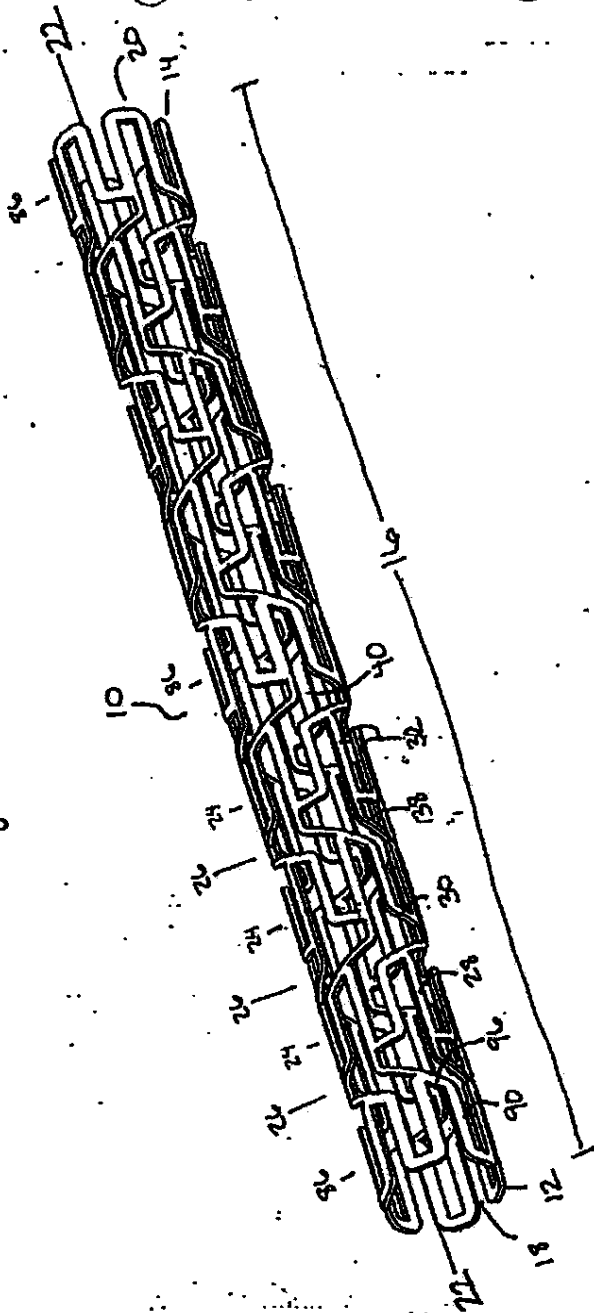
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Figure 6A



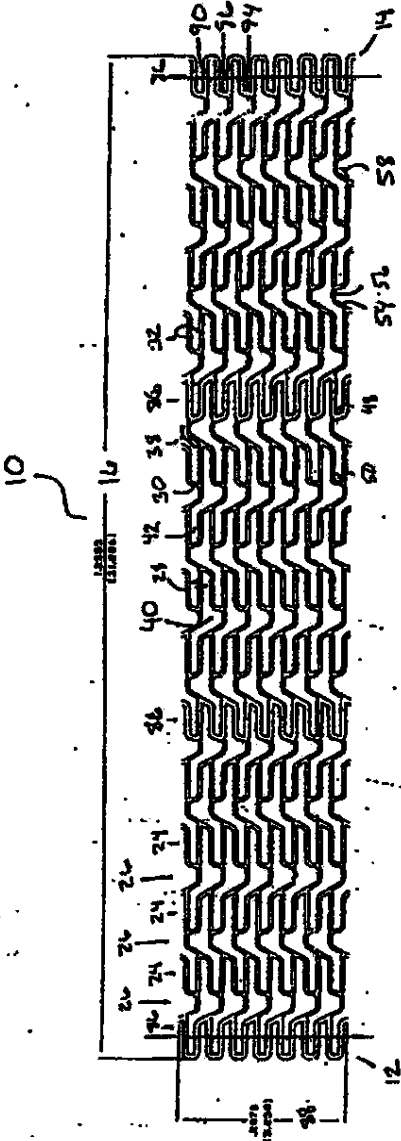
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Figure 6B



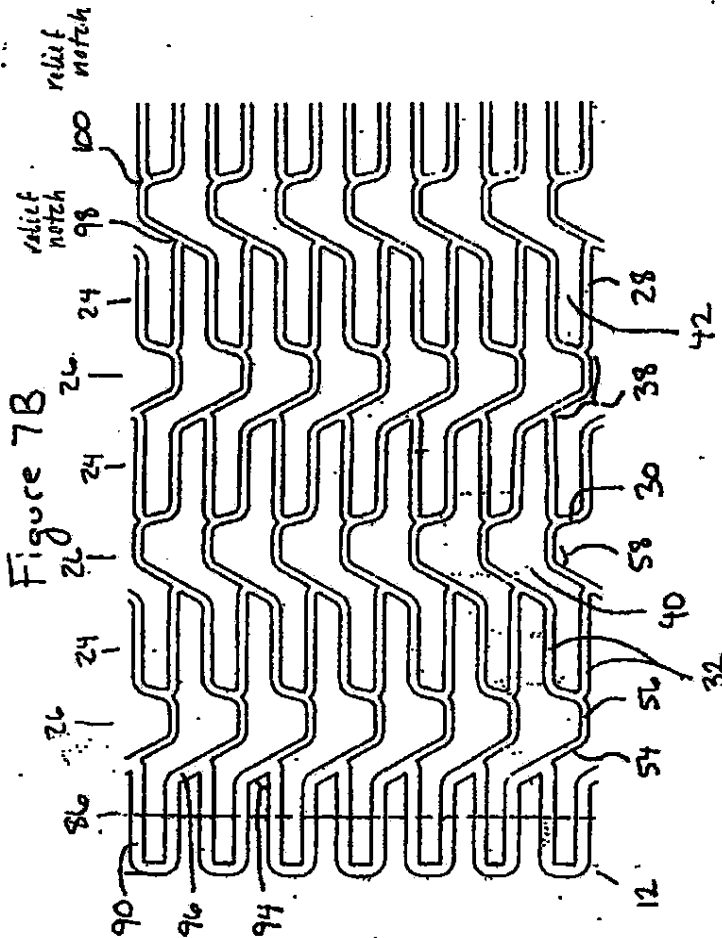
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FIGURE 7A



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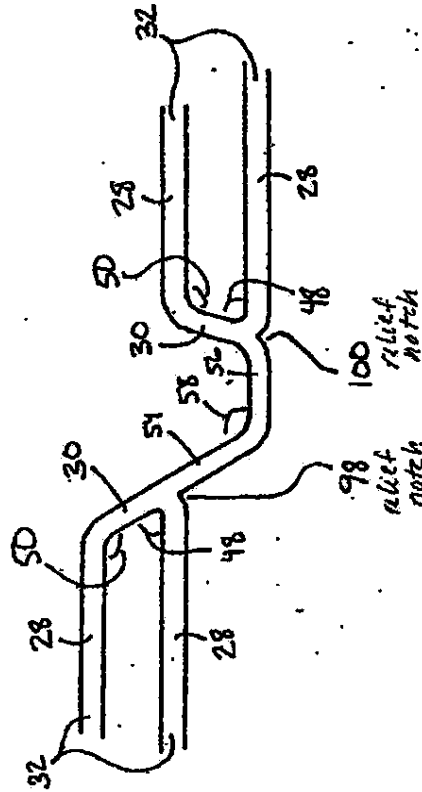
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Figure 7C



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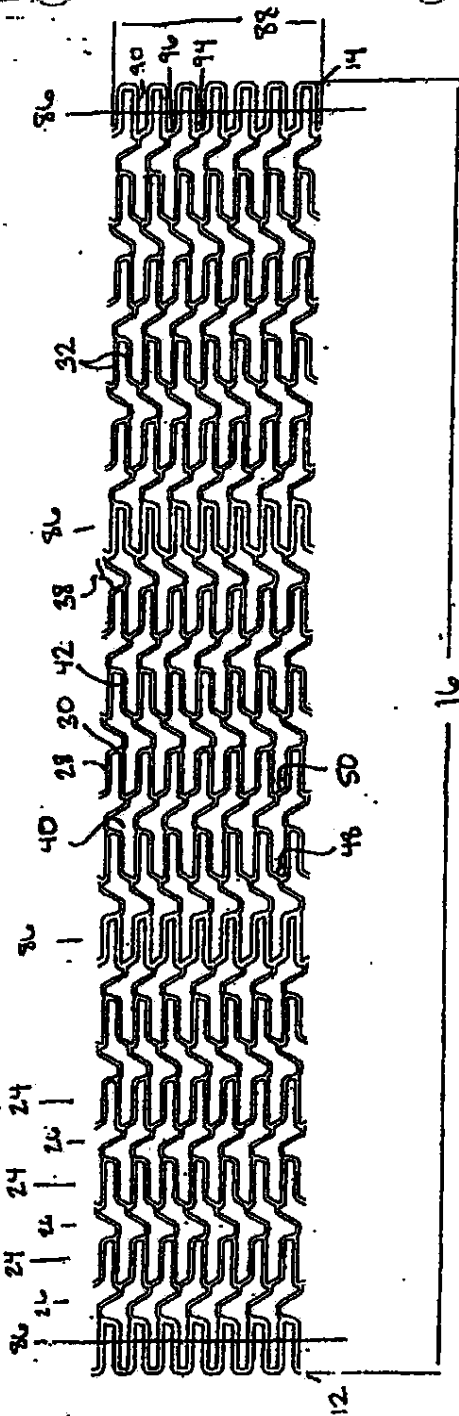


Figure 8C

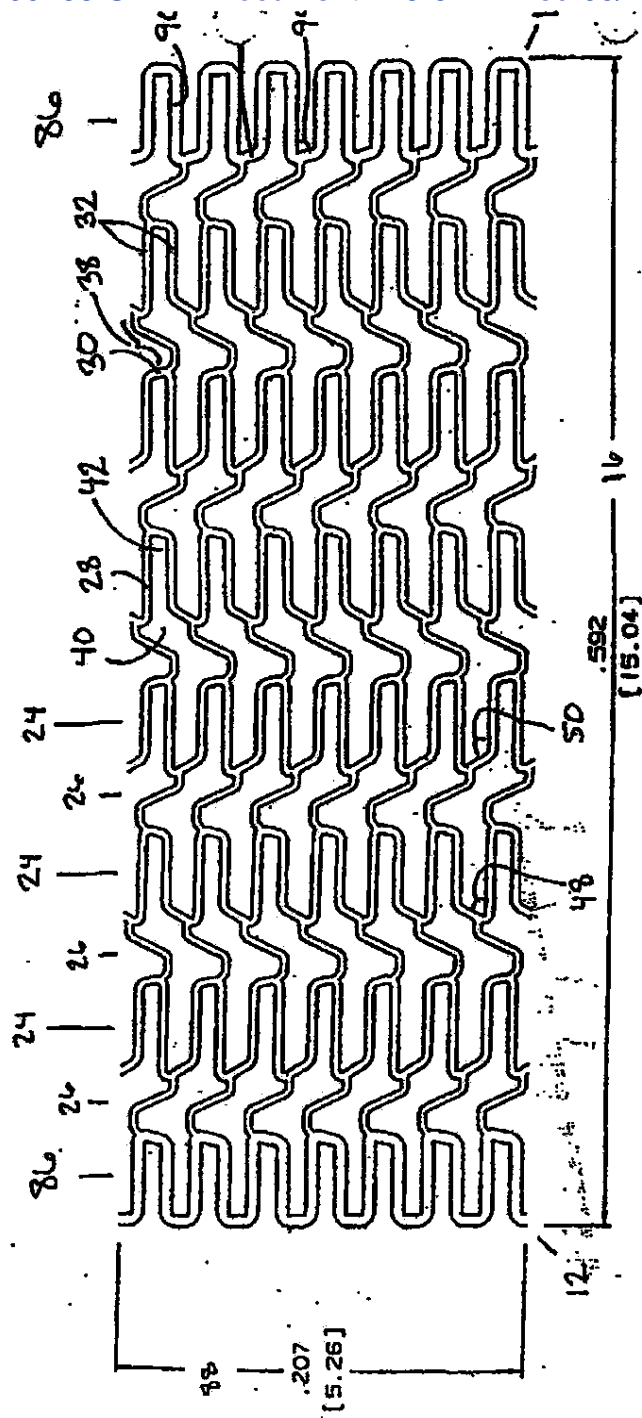
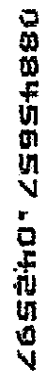


Figure 8D

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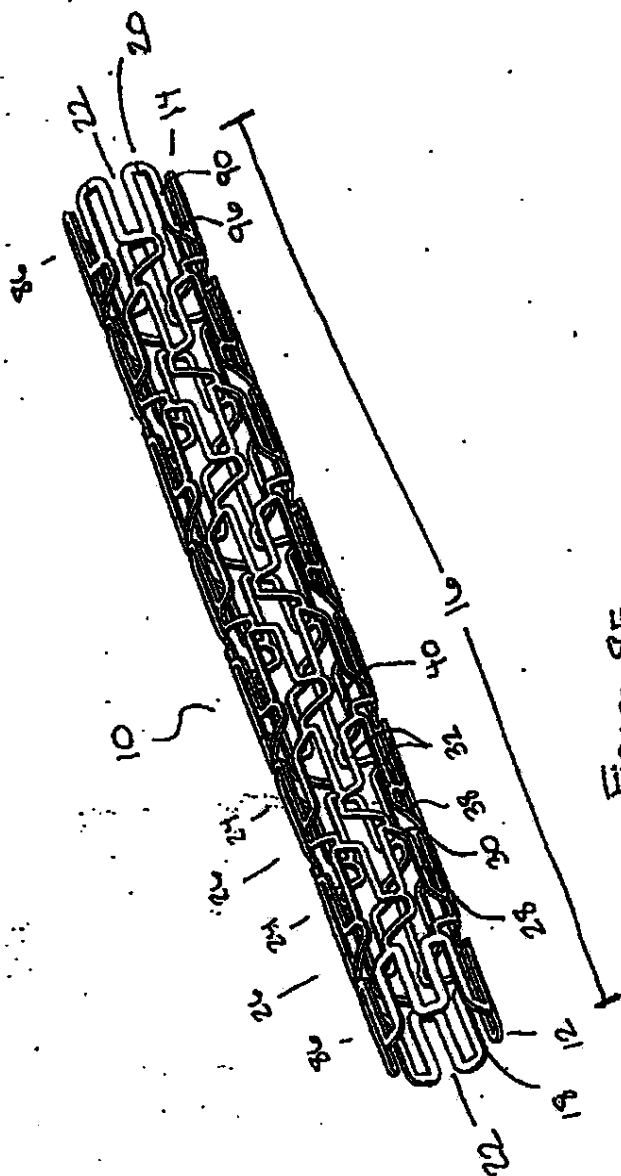


Figure 8E

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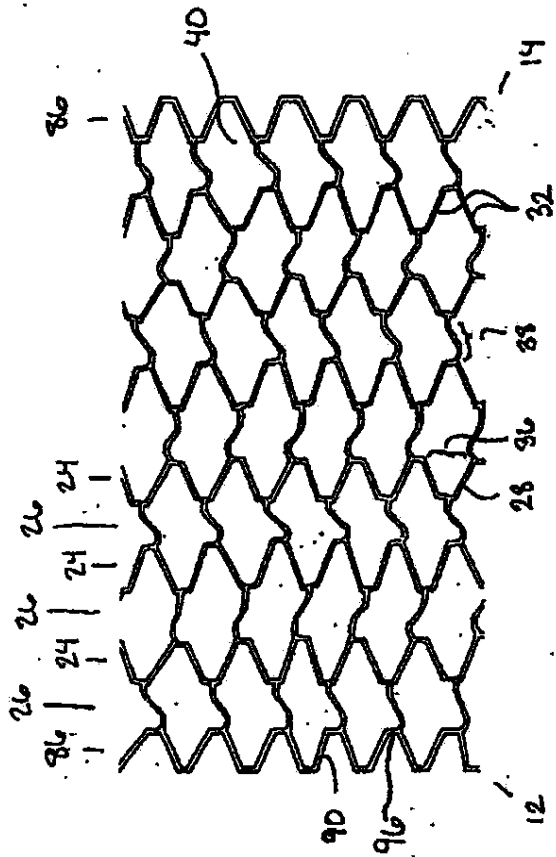


Figure 8F

08845557-045597

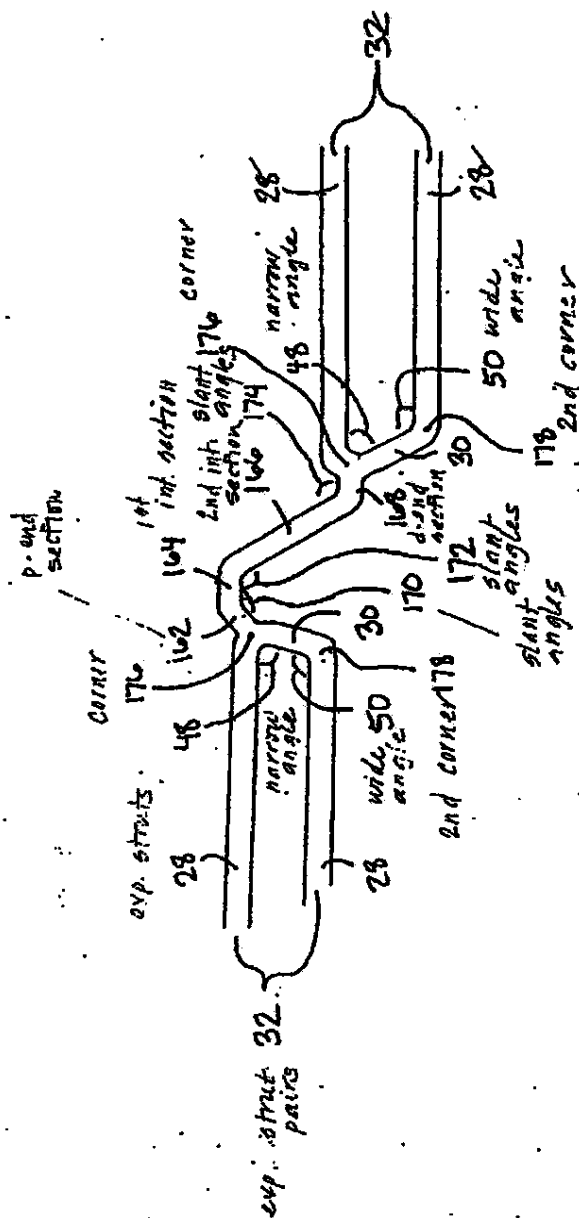


Figure 86

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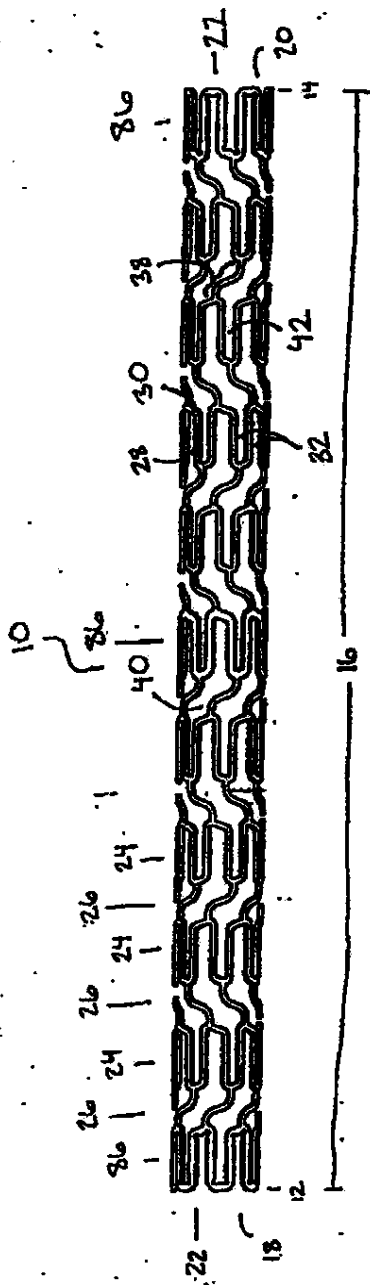


Figure 9A

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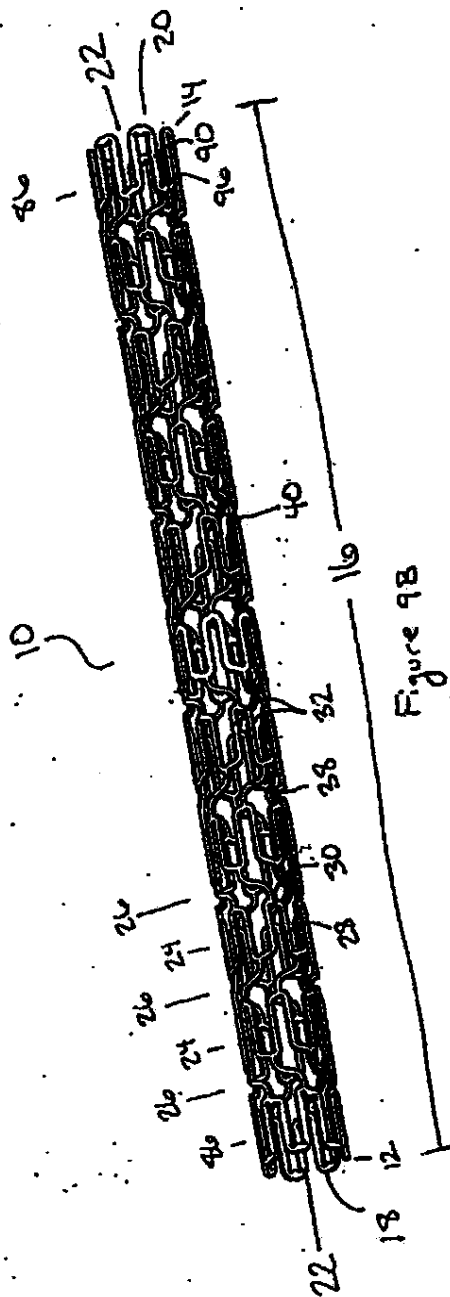


Figure 9B

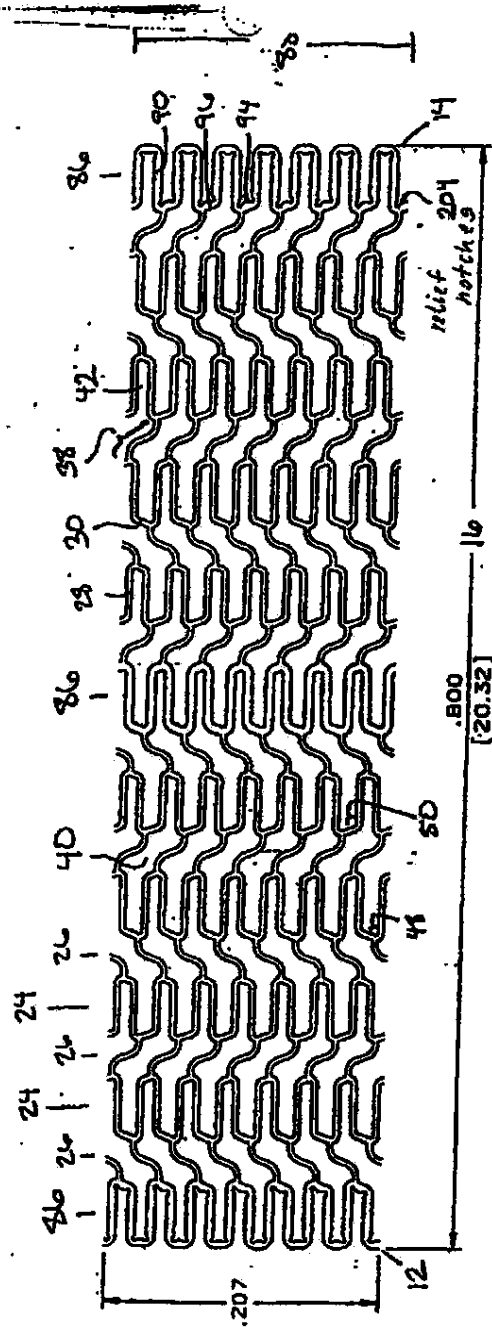


Figure 9c

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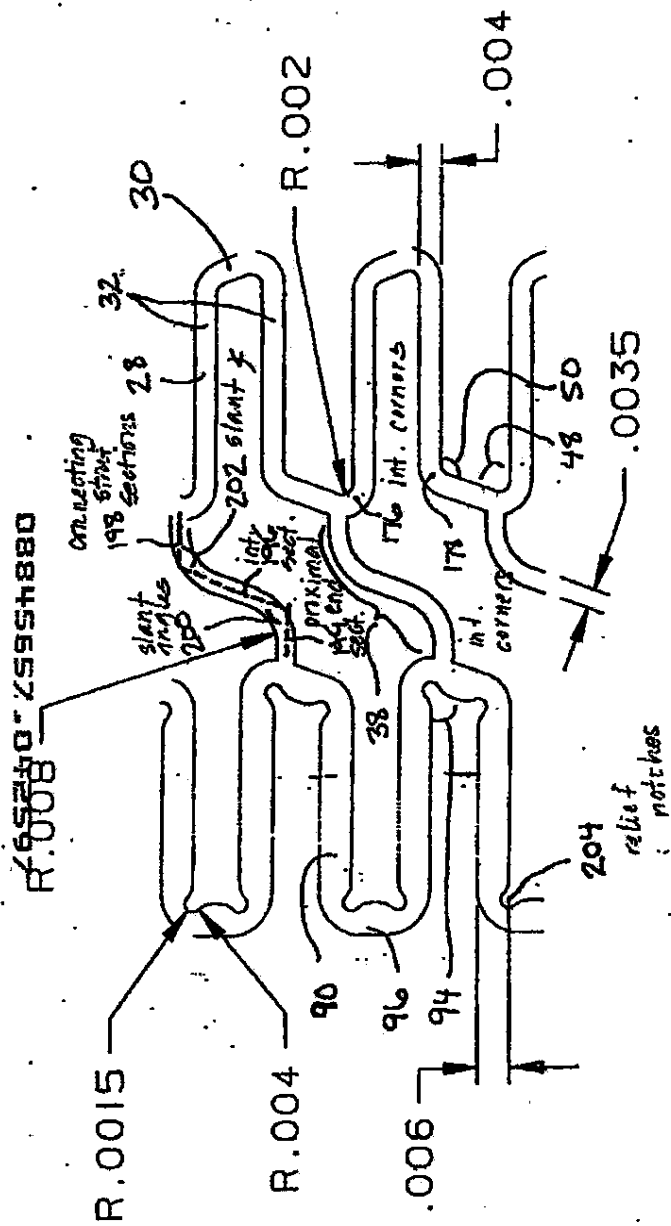


Figure 9D

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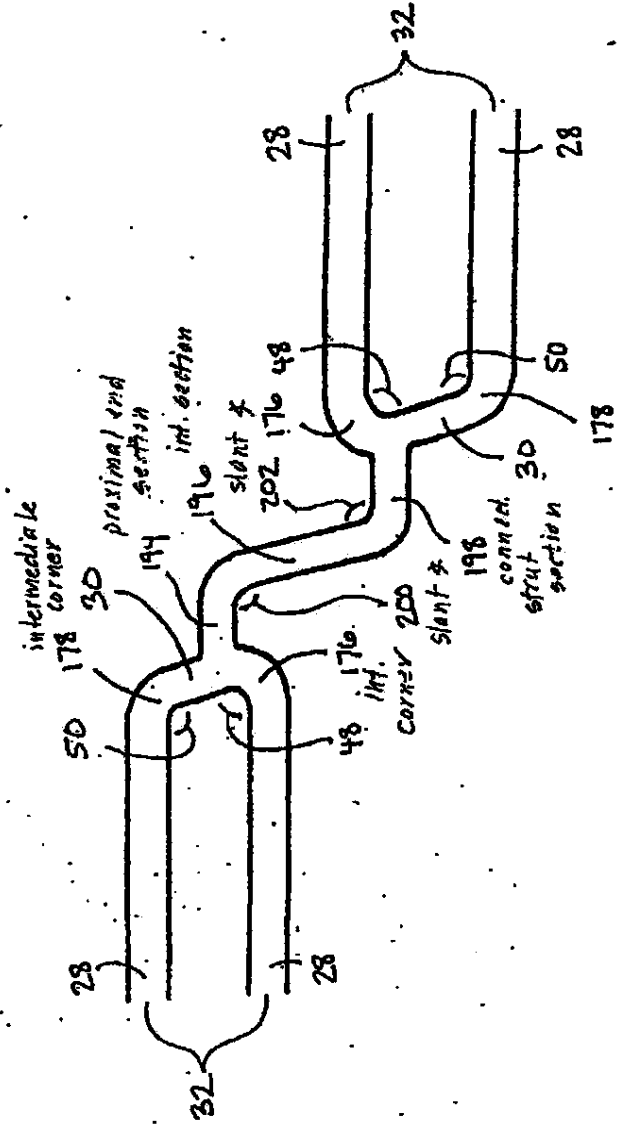


Figure 9E

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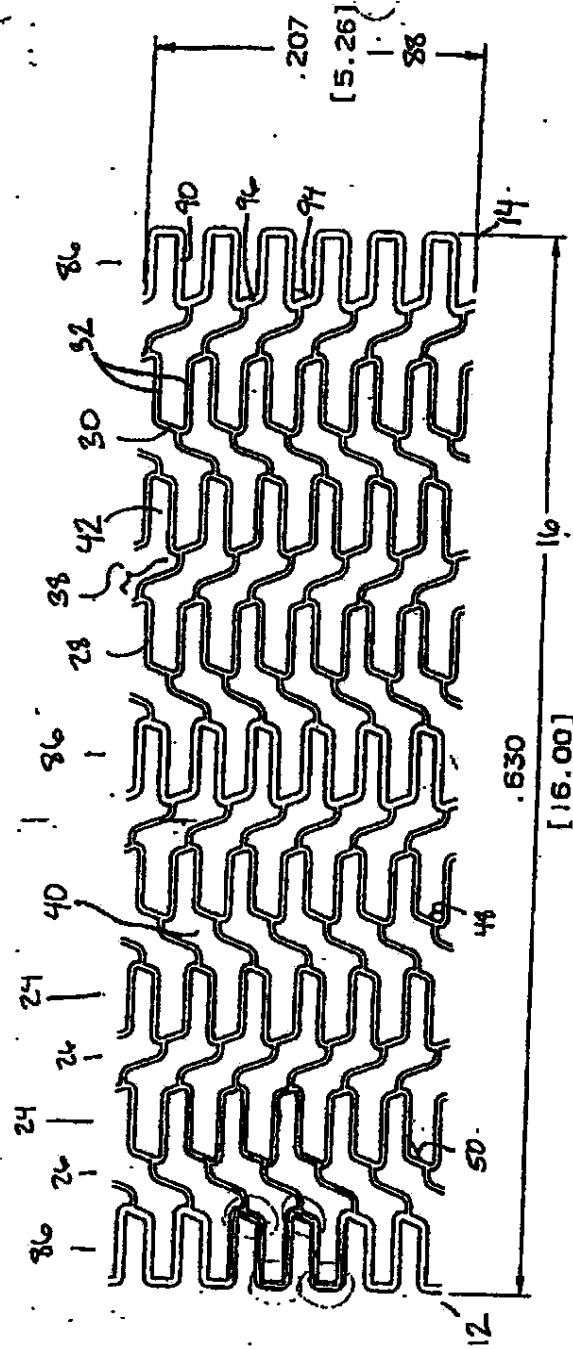
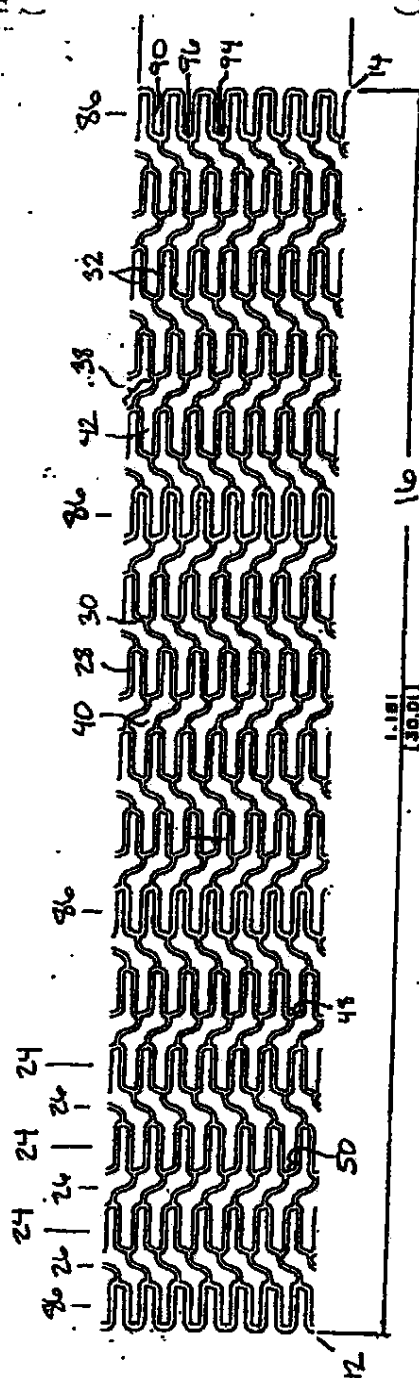


Figure 9F

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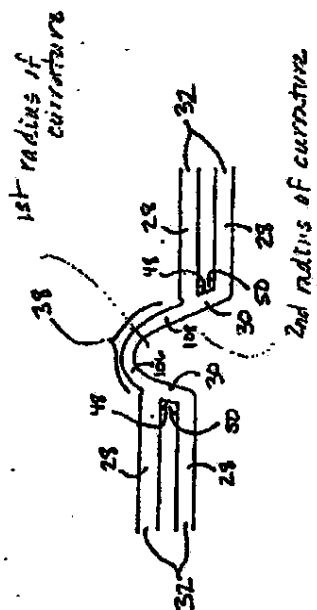


Figure 10A

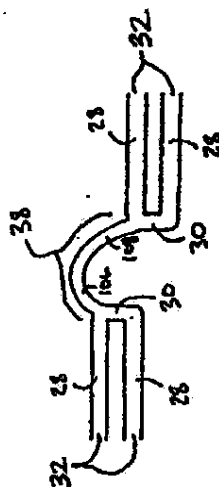


Figure 10B

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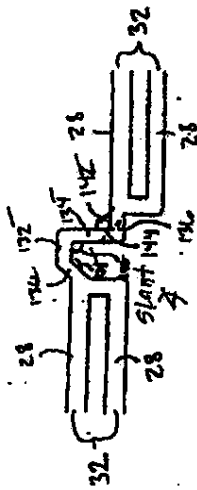
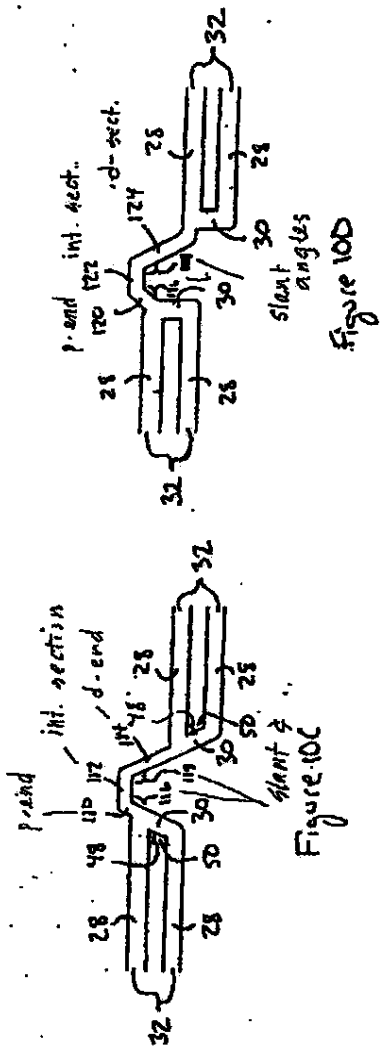
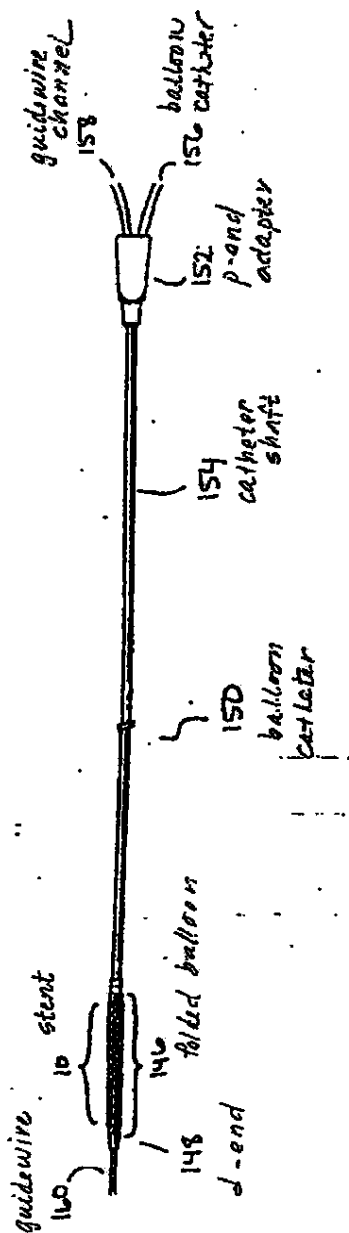


Figure 10E

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Figure 11





UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO./TITLE
08/845,657	04/25/97	JANG	G 18461.709
0292/0904		NOT ASSIGNED	
WILSON SONSINI GOODRICH AND ROSATI 650 PAGE MILL ROAD PALO ALTO CA 94304-1050			
DATE MAILED: 3308		09/04/97	

NOTICE TO FILE MISSING PARTS OF APPLICATION
Filing Date Granted

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted **ALONG WITH THE PAYMENT OF A SURCHARGE** for items 1 and 3-6 only of \$ 12.00 for a ☒ large entity ☐ small entity in compliance with 37 CFR 1.27. The surcharge is set forth in 37 CFR 1.18(e). Applicant is given **TWO MONTHS FROM THE DATE OF THIS NOTICE** within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

If all required items on this form are filed within the period set above, the total amount owed by applicant as a ☒ large entity ☐ small entity (verified statement filed), is \$ 2,352.

☒ 1. The statutory basic filing fee is:

- ☒ missing.
☐ insufficient.

Applicant must submit \$ 770 to complete the basic filing fee and/or file a verified small entity statement claiming such status (37 CFR 1.27).

☒ 2. Additional claim fees of \$ 14.00, including any multiple dependent claim fees, are required. Applicant must either submit the additional claim fees or cancel additional claims for which fees are due.

☒ 3. The oath or declaration:

- ☒ is missing.
☐ does not cover the newly submitted items.
☐ does not identify the application to which it applies.
☐ does not include the city and state or foreign country of applicant's residence.

An oath or declaration in compliance with 37 CFR 1.63, including residence information and identifying the application by the above Application Number and Filing Date is required.

☐ 4. The signature(s) to the oath or declaration is/are:

- ☐ missing.
☐ by a person other than inventor or person qualified under 37 CFR 1.42, 1.43, or 1.47.
A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

☐ 5. The signature of the following joint inventor(s) is missing from the oath or declaration:

An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying this application by the above Application Number and Filing Date, is required.

☐ 6. A \$ _____ processing fee is required since your check was returned without payment (37 CFR 1.21(m)).

☐ 7. Your filing receipt was mailed in error because your check was returned without payment.

☐ 8. The application does not comply with the Sequence Rules.

See attached "Notice to Comply with Sequence Rules 37 CFR 1.821-1.825."

☐ 9. OTHER:

Direct the response and any questions about this notice to "Attention: Box Missing Parts."

A copy of this notice MUST be returned with the response.

Customer Service Center
Initial Patent Examination Division (703) 308-1202

FORM PTO-1533 (REV. 7-96)

PART 1 - OFFICE COPY

U.S. GPO: 1996-404-400/0037



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILED/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO./TITLE
08/845,657	04/25/97	JANG	G 18461, 709

08/845,657 04/25/97 JANG

G 18461, 709

0292/0904

WILSON SONSINI GOODRICH AND ROSATI
660 PAGE-MILL ROAD
PALO ALTO CA 94304-1050

NOT ASSIGNED

DATE MAILED: 3308

09/04/97

NOTICE TO FILE MISSING PARTS OF APPLICATION

Filing Date Granted

An Application Number and Filing Date have been assigned to this application. However, the items indicated below are missing. The required items and fees identified below must be timely submitted ALONG WITH THE PAYMENT OF A SURCHARGE for items 1 and 3-6 only of \$ 120 for a ☒ large entity ☐ small entity in compliance with 37 CFR 1.27. The surcharge is set forth in 37 CFR 1.16(e). Applicant is given TWO MONTHS FROM THE DATE OF THIS NOTICE within which to file all required items and pay any fees required above to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

If all required items on this form are filed within the period set above, the total amount owed by applicant as a

☒ large entity ☐ small entity (verified statement filed), is \$ 4,352.

☒ 1. The statutory basic filing fee is:

☒ missing.

☐ insufficient.

Applicant must submit \$ 770 to complete the basic filing fee and/or file a verified small entity statement claiming such status (37 CFR 1.27).

☒ 2. Additional claim fees of \$ 1452, including any multiple dependent claim fees, are required.

Applicant must either submit the additional claim fees or cancel additional claims for which fees are due.

☒ 3. The oath or declaration:

☒ is missing.

☐ does not cover the newly submitted items.

☐ does not identify the application to which it applies.

☐ does not include the city and state or foreign country of applicant's residence.

An oath or declaration in compliance with 37 CFR 1.63, including residence information and identifying the application by the above Application Number and Filing Date, is required.

☐ 4. The signature(s) to the oath or declaration were:

☐ missing.

☐ by a person other than inventor or person qualified under 37 CFR 1.42, 1.43, or 1.47.

A properly signed oath or declaration in compliance with 37 CFR 1.63, identifying the application by the above Application Number and Filing Date, is required.

☐ 5. The signature of the following joint inventor(s) is missing from the oath or declaration:

An oath or declaration listing the names of all inventors and signed by the omitted inventor(s), identifying the application by the above Application Number and Filing Date, is required.

☐ 6. A \$ 120 processing fee is required since your check was returned without payment (37 CFR 1.21(e)).

☐ 7. Your filing receipt was mailed in error because your check was returned without payment.

☐ 8. The application does not comply with the Sequence Rules.

See attached Notice to Comply with Sequence Rules 37 CFR 1.821-1.825.

☐ 9. OTHER:

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A copy of this notice **MUST** be returned with the response.

Customer Service Center
Initial Patent Examination Division (703) 308-1202

FORM PTO-1530 (REV. 7-99)

PART 2-COPY TO BE RETURNED WITH RESPONSE



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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on October 8, 1997

Sidney M. Berman

PATENT

Attorney Docket No. 18461-709

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

G. David Jang

Application No.: 08/845,657

Filed: April 25, 1997

For: INTRAVASCULAR STENT

Group Art Unit: Unassigned

Examiner: Unassigned

TRANSMITTAL LETTER FOR MISSING PARTS OF APPLICATION

Assistant Commissioner for Patents

Attn: Application Processing Division

Special Processing and Correspondence Branch

Washington, D.C. 20231

Sir:

In complete response to the Notice to File Missing Parts of Application mailed September 4, 1997,

enclosed please find:

- ☒ Form PTO-1533 (copy of Notice to be returned with response);
- ☐ a Petition for Extension of Time;
- ☐ a Declaration for Patent Application
- or ☒ a Combined Declaration and Power of Attorney
signed by the inventor(s) and the surcharge of
☒ \$65.00 ☐ \$130.00 as set forth in 37 CFR § 1.16(c);
- ☒ a Declaration Claiming Small Entity Status;
- ☐ an Assignment document, Form PTO-1595, and the \$40.00 Assignment Recordation Fee;
- ☐ a Preliminary Amendment.

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Application No. 08/824,657
Page 2

Patent Application Filing Fee

The patent application filing fee (if applicable) is calculated as shown below:

	NO. OF CLAIMS		EXTRACLAIMS	RATE	FEE
Basic Application Fee					\$ 790.00
Total Claims	86	MINUS 20=	66	x \$22 =	1,452.00
Independent Claims	3	MINUS 3 =	0	x \$82 =	0.00
If multiple dependent claims are presented, add \$270.00					0.00
Total Application Fee-(LARGE ENTITY)					2,242.00
If verified statement claiming small entity status is enclosed, subtract 50% of Total App. Fee					-1,121.00
PATENT APPLICATION FILING FEE					1,121.00

Total Fee

The Total Fee associated with this communication has been calculated as shown below:

<input checked="" type="checkbox"/> Patent application filing fee	\$ 1,121.00
<input type="checkbox"/> Net fee for extension of time	\$ _____
<input type="checkbox"/> Assignment recordation fee	\$ _____
<input checked="" type="checkbox"/> Surcharge under 37 C.F.R. §1.16(c) for late filing of oath or declaration	\$ _____
Large Entity (\$130.00)	\$ _____
<input checked="" type="checkbox"/> Small Entity (\$65.00)	\$ 65.00
TOTAL FEE DUE:	\$ 1,186.00

Method of Payment of Fees

- ☐ A check in the amount of \$ _____
☒ Charge \$1,186.00 to Deposit Account No. 23-2415 (Docket No. 18461-709).

The Commissioner is hereby authorized to charge any fees that may be required by this paper, including petition fees, to Deposit Account No. 23-2415 (Docket No. 18461-709). A duplicate of this paper is enclosed.

Respectfully submitted,
WILSON, SONNINI, GOODRICH & ROSATI

Date: 6/8/97

By 
Paul Davis, Reg. No. 29,294

650 Page Mill Road
Palo Alto, CA 94304-1050
(415) 493-9300

RP/PRVATE/WT/DOCS/PTD/ANGUW/MF

08/22/97 15:08 WILSON, DOMINIC + 9037941938

NO. 271 P.003



PATENT
 Attorney Docket No. 18461-709

**COMBINED CIP DECLARATION AND POWER OF ATTORNEY
 FOR UTILITY PATENT APPLICATION**

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

INTRAVASCULAR STENT

the specification of which

is attached hereto.

X was filed on April 25, 1997 as Application No. 08/045,657

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56(a) which states in relevant part: "Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section....The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98."

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate as indicated below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):

Priority Claimed

(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as this is a continuation-in-part application filed under the conditions set forth in 35 United States Code, §120, which discloses and claims subject matter in addition to the prior pending application(s) listed below, I acknowledge the duty to disclose to the

U.S. PATENT & TRADEMARK OFFICE

09/22/97 15:08 WILSON TOSINI + 9097941938

NO. 271 P004

Attorney Docket No. 18461-709

United States Patent Office all information known to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

<u>08/845,734</u> (Application Serial No.)	<u>April 25, 1997</u> (Filing Date)	<u>Pending</u> (Patented, Pending, Abandoned)
<u>08/824,142</u> (Application Serial No.)	<u>March 25, 1997</u> (Filing Date)	<u>Pending</u> (Patented, Pending, Abandoned)
<u>08/824,866</u> (Application Serial No.)	<u>March 26, 1997</u> (Filing Date)	<u>Pending</u> (Patented, Pending, Abandoned)
<u>08/824,865</u> (Application Serial No.)	<u>March 25, 1997</u> (Filing Date)	<u>Pending</u> (Patented, Pending, Abandoned)
<u>60/017,486</u> (Application Serial No.)	<u>April 26, 1996</u> (Filing Date)	<u>Pending</u> (Patented, Pending, Abandoned)

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith, and to file, prosecute and to transact all business in connection with international applications directed to said invention:

Paul Davis	29,294
Mark A. Haynes	30,846
David J. Weiss	38,362
Kent R. Richardson	39,443
Charles C. Cury	36,764

Address all correspondence to:

Paul Davis
Wilson, Sonzogni, Goodrich & Rosati
650 Page Mill Road
Palo Alto, CA 94304

Direct all telephone calls to Paul Davis at (415) 493-9340.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Title 18, United States Code, §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

W:\STATE\TOSINI\WILSON.DOC

-2-

09/22/97 15:00

WILSON-CONSINI • 9897341538

NO.271 P005

Attorney Docket No. 18461-709

Full name of sole or
first inventor:

G. David Jung

Inventor's signature:

[Handwritten signature]

Date:

9-20-97

Citizenship:

US

Residence:

30725 Eastern Lane, Redlands, CA 92374

Post Office Address:

Same as above

INVENTOR'S SIGNATURE PAGE 00000000.DOC

-3-

09/22/97 15:09

WILSON-GUNJINI + 9097941930

NO. 271 PAGE

At Docket No. 10461-709



**VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS
37 C.F.R. 1.15(a) AND 1.70(a) - INDEPENDENT INVENTOR**

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 C.F.R. §1.9(c) for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled:

INTRAVASCULAR STENT

described in

the specification filed herewith
☒ application no. 08/445,657, filed April 25, 1997
 patent no. _____, issued _____

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 C.F.R. §1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 C.F.R. §1.9(d) or a nonprofit organization under 37 C.F.R. §1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

☒ no such person, concern, or organization
 persons, concerns or organizations listed below

NAME:
ADDRESS:

☐ Individual ☐ Small Business Concern ☐ Nonprofit Organization

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small business entity is no longer appropriate. (37 C.F.R. §1.26(b)).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Name of Person Signing: G. David Jung
 Title of Person Signing: _____
 Address of Person Signing: 30724 Eastman Lane, Redlands, CA 92374
 Signature: [Signature]
 Date: 9-20-97

* Note: Separate verified statements are required from each named person, concern or organization having rights in the invention owing to their status as small entities. (37 C.F.R. §1.171).

\\PRIVATE\MPDOCS\PM\JUNG\97.052



CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on November 3, 1997

Drew R. Herndon

(Typed or Printed Name of Person Mailing Paper or Fee)

Drew R. Herndon
(Signature of Person Mailing Paper or Fee)

PATENT

Attorney Docket No. 18461-709

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application

Inventor(s): G. David Jang

Application No.: 08/845,657

Filed: April 25, 1997

Title: INTRAVASCULAR STENT

) **PATENT APPLICATION**

)

) Art Unit: Unknown

) Examiner: Unknown

)

)

RECEIVED

DEC 3 1997

INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. § 1.97

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Listed below or on an attached Form PTO-1449 is information known to applicant(s). A copy of each listed publication and U.S. and foreign patent, except for pending U.S. applications, is being submitted herewith, along with a concise explanation of information in a foreign language, if any, pursuant to 37 C.F.R. §1.97-1.98.

Applicants respectfully request that the listed information be considered by the Examiner and be made of record in the above-identified application. If form PTO-1449 is enclosed, the Examiner is requested to initial and return it in accordance with MPEP §609.

This statement is not intended to represent that a search has been made or that the information cited in the statement is, or is considered to be, material to patentability as defined in §1.56.

- 1 -

::ODMA\PCDOCS\SQL\183390\1
Attorney Docket No.: 18461-709

JFH 186.1

X This statement qualifies under 37 C.F.R. §1.97, subsection (b) because (check all that apply):

- ☐ (1) It is being filed within 3 months of the application filing date
— OR —
- ☐ (2) It is being filed within 3 months of entry of a national stage
— OR —
- X (3) It is being filed before the mail date of the first Office Action on the merits.

☐ 37 C.F.R. §1.97(c). If this statement is being filed after the latest of: (1) three months beyond the filing date of a national application; (2) three months beyond the date of entry of the national stage as set forth in §1.491 in an international application; or (3) the mailing date of a first Office action on the merits, but before the mailing date of the earlier of a final office action under §1.113 or a notice of allowance under §1.311, then:

- ☐ a certification as specified in §1.97(e) is provided below; or
- ☐ a fee of \$240.00 as set forth in §1.17(p) is authorized below, enclosed, or included with the payment of other papers filed together with this statement.

☐ 37 C.F.R. §1.97(d). If this statement is being filed after the mailing date of the earlier of a final office action under §1.113 or a notice of allowance under §1.311, but before payment of the issue fee, then:

- A. a certification as specified in §1.97(e) is completed below; and
- B. a petition under 37 C.F.R. §1.97(d) requesting consideration of this statement is submitted herewith; and
- C. a fee of \$130.00 as set forth in §1.17(i)(1) is authorized below, enclosed, or included with the payment of other papers filed together with this statement.

X Fee Authorization. The Commissioner is hereby authorized to charge the above-referenced fees of \$ 0 and charge any additional fees or credit any overpayment associated with this communication to Deposit Account No. 23-2415 (Docket No. 18461-709).

Respectfully submitted,

WILSON SONSDY GOODRICH & ROSATI

Date: 11/3/97

By: Paul Davis


Paul Davis
Reg. No. 29,294

650 Page Mill Road
Palo Alto, CA 94304-1050
(650) 493-9300

- 2 -

==ODMAVPCDCS\$QL111833901
Attorney Docket No.: 18461-709

SHEET 1 OF 1

 INFORMATION DISCLOSURE CITATION PTO-1449		ATTY. DOCKET NO. 18461-709		SERIAL NO. 08/045,657			
		APPLICANT G. David Jung					
		FILING DATE April 25, 1997		GROUP Unknown 3308			
U.S. PATENT DOCUMENTS							
EXAMINER'S INITIALS	PATENT NO.	DATE	NAME	CLASS	SUBCLASS	FILING DATE	
Ten	5,449,373	9-24-95	Pinchask et al.	606	198	3-17-94	
FOREIGN PATENT DOCUMENTS							
EXAMINER'S INITIALS	PATENT NO.	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
						YES	NO
Ten	0 709 067 A2	04/02/96	Europe	A61F	2/06		
	0 679 372 A2	02/11/95	Europe	A61B	19/00		
	0 587 197 A1	15/03/94	Europe	A61F	2/04		
	WO96/03029	04/02/96	PCT	A61F	2/02		
	WO96/26689	06/09/96	PCT	A61F	2/06		
	29608037 U1	28/08/96	Germany	A61M	29/00		
Ten	4303181 A1	01/08/94	Germany	A61M	29/00		
OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)							
EXAMINER TRAM NGUYEN			DATE CONSIDERED 12/14/97				

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

15391VATB7W7DOCSF0VANGUDES149.209

JFH 000188



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
09/845,657	04/25/97	JANG	G 18461.709

33M1/0127
PAUL DAVIS
WILSON SONSINI GOODRICH & ROSATI
650 PAGE MILL ROAD
PALO ALTO CA 94304-1050

EXAMINER	
NGUYEN, T	
ART UNIT	PAPER NUMBER
3308	

DATE MAILED: 01/27/98

Please find below a communication from the EXAMINER in charge of this application.

Commissioner of Patents

PTOL-90 (Rev. 6/94)

1 - PATENT APPLICATION FILE COPY

JFH 000189

Office Action Summary	Application No. 08/845,857	Applicant(s) JANG
	Examiner Tram Nguyen	Group Art Unit 3308

☒ Responsive to communication(s) filed on Apr 25, 1997

☐ This action is FINAL.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 463 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.135(a).

Disposition of Claims

☒ Claim(s) 1-86 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1-3, 5, 7-18, 21, 24-30, 39-45, 48-60, 52-58, 60-62, 64, 66-73, 76, and 79 are rejected.

☒ Claim(s) 4, 6, 19, 20, 22, 23, 31-38, 46, 47, 51, 53, 63, 65, 74, 75, 77, 78, and 80 are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☒ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-848.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ Approved ☐ Disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(a).

Attachment(s)

☐ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 4

☐ Interview Summary, PTO-413

☒ Notice of Draftsperson's Patent Drawing Review, PTO-848

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

Serial Number: 08/845,657
Art Unit: 3308

Page 2

Drawings

1. This application has been filed with informal drawings which are acceptable for examination purposes only. Formal drawings will be required when the application is allowed.

Specification

2. The disclosure is objected to because of the following informalities:
 - (a) On page 1, lines 5-16 contain blank spaces which need to be filled in with the appropriate information. In line 27, replace "alterative" with -- alternative --.
 - (b) On page 4, line 10, replace "axio-lateral" with -- axio-laterally --.
 - (c) On page 16, line 19, after "way" insert -- to --.
 - (d) On page 17, line 11, replace "Reenforcement" with -- reenforcement --.

Appropriate correction is required.

Claim Objections

3. Claims 3-6 are objected to because of the following informalities:
 - (a) Regarding claims 3-6, applicant should delete the "column" from "first expansion column strut pair" and "second column expansion strut pair", to keep claim terminology consistent with claim 1 upon which these claims depend. Appropriate correction is required.

Serial Number: 08/845,657
Art Unit: 3308

Page 3

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless —

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. Claims 1-3, 5, 7-18, 21, 24-30, 39-45, 48-50, 52-58, 60-62, 64, 66-73, 76 and 79 are rejected under 35 U.S.C. 102(b) as being anticipated by Pinchasik et al. (BP 079 067 A2), for the following reasons:

(a) With respect to claims 1, 5, 16, 18, 24-29, 39, 40, 44, 45, 48, 50, 52-56, 58, 66, 71, 72, and 76, see refer to the modified Figure 2 attached to this office action, wherein:

20A represents the first expansion column;

20B represents the second expansion column;

20C represents the third expansion column;

30A represents the first connecting strut column; and

30B represents the second connecting strut column.

(b) With respect to claims 7-12, in so far as applicant has not recited any particular radius of curvature or slant angle, please refer to the modified Figure 2 attached to this office action.

(c) With respect to claims 17 and 57, please refer to the modified Figure 2 attached to this office action, wherein $m = 2$.

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Page 4

- (d) With respect to claims 21 and 64, please refer to the modified Figure 2 attached to this office action, wherein the far left edge defines the first reinforcement column, and the far right edge defines the second reinforcement column.
- (e) With respect to claims 30 and 70, please refer to the modified Figure 2 attached to this office action, wherein at least a portion within the configurations are symmetrical.
- (f) With respect to claims 2, 41-43, 49, 60-62, 67-69, and 73, please refer to Figure 2A of Pinchasik et al.
- (g) With respect to claim 79, in so far as this stent formed from etched sheet metal which expands when pressure is internally applied (col. 1, lines 5-8 and col. 2, lines 25-33), it is inherent that the stent is configured to be positioned at an exterior of an expandable balloon.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pinchasik et al. '067 in view of Lam et al. (EP 0 679 372 A2), for the following reasons:

With respect to claims 13-15, Pinchasik et al. discloses the invention substantially as claimed (please refer to the modified Figure 2 attached to this office action). However, Pinchasik et al. fails to disclose that at least the ends of the stent include an electroplated material for use as

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Page 5

a radiopaque marker. Lam et al. teaches plating the ends of an expandable stent with gold for use as a radiopaque marker (col. 2, lines 13-58 and col. 3, lines 1-15) so that the location, length, and diameter of the stent can be determined under fluoroscopy. It would have been obvious to one of ordinary skill in the art at the time of the invention to have goldplated the ends of the expandable stent of Pinchasik et al., as taught by Lam et al., so that the location, length, and diameter of the stent can be determined under fluoroscopy.

Allowable Subject Matter

8. Claims 4, 6, 19, 20, 22, 23, 31-38, 46, 47, 51, 59, 63, 65, 74, 75, 77, 78, and 80-86 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Fischell et al. (U.S. Patent No. 5,697,971), Fischell et al. (U.S. Patent No. 5,695,516), Klein (U.S. Patent No. 5,593,442), Orth et al. (U.S. Patent No. 5,591,197), and Miksza (EP 606 165 A1) all show various features of the claimed invention.

Serial Number: 08/845,657
Art Unit: 3308

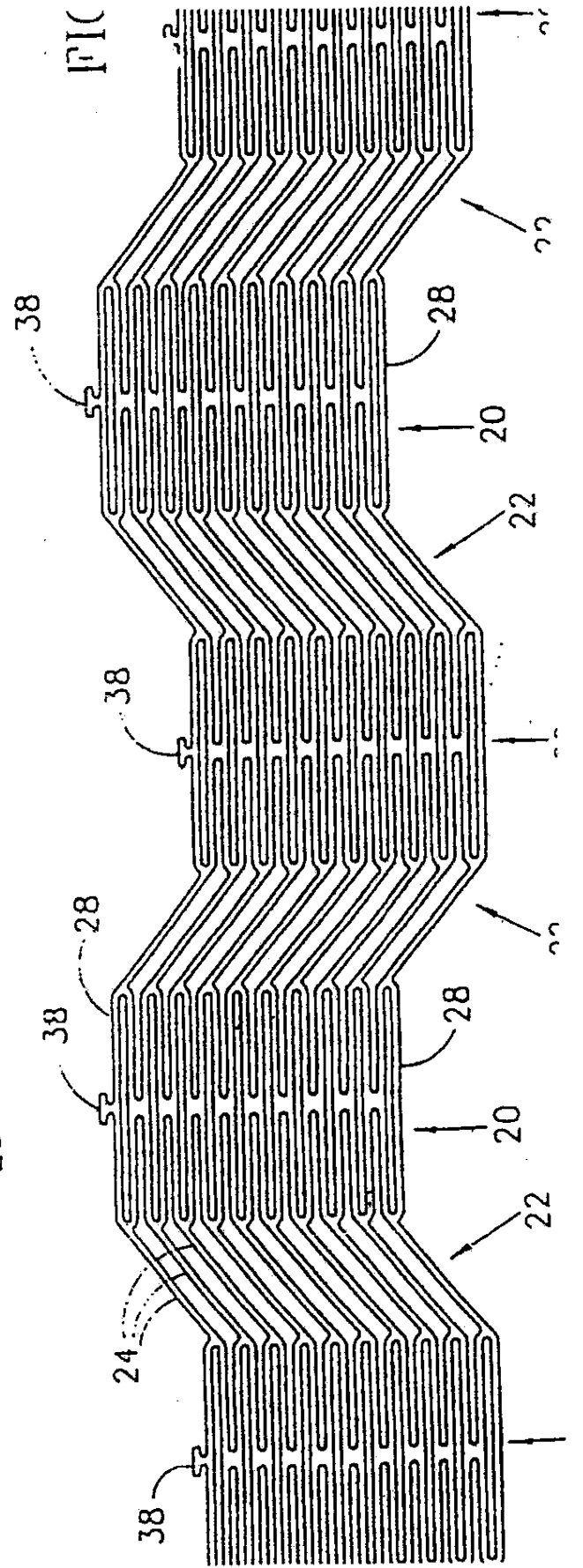
Page 6

Any inquiry concerning this communication or earlier communications regarding this application should be directed to Tram Nguyen at (703) 308-0804/(703)305-3590 (FAX). If you are unable to reach me, please contact my supervisor, John Weiss, at (703) 308-2702. In a case requiring immediate assistance, please call (703) 308-0858 to reach the main operator.

TAN
TAN
January 20, 1998

Michael J. Milano
MICHAEL J. MILANO
PRIMARY EXAMINER
ART UNIT 3308

1. The first of these is the fact that the
 2. second of these is the fact that the
 3. third of these is the fact that the
 4. fourth of these is the fact that the
 5. fifth of these is the fact that the
 6. sixth of these is the fact that the
 7. seventh of these is the fact that the
 8. eighth of these is the fact that the
 9. ninth of these is the fact that the
 10. tenth of these is the fact that the



Notice of References Cited			Application No. 06/845,857		Applicant(s) JANG	
			Examiner Tram Nguyen		Group Art Unit 3308	
					Page 1 of 1	
U.S. PATENT DOCUMENTS						
		DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS
A		5,697,071	12/1997	Flachell et al.	623	1
B		5,086,518	12/1997	Flachell et al.	606	194
C		5,593,442	1/1997	Klein	623	1
D		5,591,197	1/1997	Orth et al.	606	194
E						
F						
G						
H						
I						
J						
K						
L						
M						
FOREIGN PATENT DOCUMENTS						
		DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS
N		606 185 A1	7/1994	EP	Mikaza	623
O						
P						
Q						
R						
S						
T						
NON-PATENT DOCUMENTS						
		DOCUMENT (including Author, Title, Source, and Pertinent Pages)				DATE
U						
V						
W						
X						

5-3-1

40 3304 49407

EP 000690105 41
JUL 1994

★ ETNI P22 94-215505/27 ★ EP 000105-A1
Stent for blood vessel or bile duct - comprises open-ended tube with slots which are rounded, and includes intermediate articulating section (Eng)

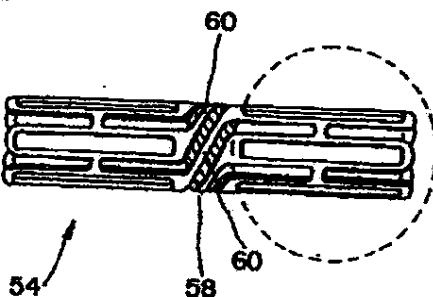
ETHICON INC 94.01.06 93US-000897
(94.07.13) A61F 2/00

94.01.06 94EP-300084 R(BE DE DK ES FR GB IE IT LU NL PT)
The stent (54) comprises a hollow tube open at both stent ends and having a series of slots, with the stent ends and the slots being rounded. The stent provides smooth surfaces, obviating the abrading of the body passageway. The stent is provided with an articulating section at an intermediate position along the longitudinal length of the stent.

The articulating section comprises bendable struts. The stent is mounted on an inflatable balloon capable of providing an expanding force for the radial expansion of the stent.

ADVANTAGE - Is radially expanded within a body passageway from a first to a second diameter by the inelastic deformation of the material of which the stent is comprised. (11pp Dwg.No.4/5)

CT: EP274846 EP336341 US5102417 US5168548
N94-173745



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Attachment 5

The drawings submitted with this application were declared informal by the applicant. Accordingly they have not been reviewed by a draftsperson at this time. When formal drawings are submitted, the draftsperson will perform a review.

Direct any inquires concerning drawing review to the Drawing Review Branch (703) 305-8404.



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER <u>09/345,657</u>	FILING DATE <u>04/25/97</u>	FIRST NAMED APPLICANT <u>JANG</u>	ATTORNEY DOCKET NO. <u>18461.709</u>
---	--------------------------------	--------------------------------------	---

EXAMINER
T. NGUYEN

ART UNIT
3738

PAPER NUMBER
6

DATE MAILED:

INTERVIEW SUMMARY

All participants (applicant, applicant's representative, PTO personnel):

(1) PAUL Davis

(3) David Willse

(2) Tram Nguyen

(4)

Date of interview 05 June 1998

Type: ☐ Telephonic ☒ Personal (copy is given to ☐ applicant ☒ applicant's representative)

Exhibit shown or demonstration conducted: ☐ Yes ☒ No If yes, brief description:

Agreement ☒ was reached, ☐ was not reached.

Claim(s) discussed: claims 1 and 24

Identification of prior art discussed: Pinchasik et al. '373

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:

Proposed claim language was discussed, which language appears to distinguish applicant's invention over the art of record. Applicant is encouraged to submit the proposed language to claims 1 and 24 in a formal amendment.

(A fuller description, if necessary, and a copy of the amendments, if available, which the examiner agreed would render the claims allowable, must be attached. Also, where no copy of the amendments which would render the claims allowable is available, a summary thereof must be attached.)

1. ☒ It is not necessary for applicant to provide a separate record of the substance of the interview.

Unless the paragraph above has been checked to indicate to the contrary, A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION IS NOT WAIVED AND MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a response to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW.

2. ☐ Since the Examiner's interview summary above (including any attachments) reflects a complete response to each of the objections, rejections and requirements that may be present in the last Office action, and since the claims are now allowable, this completed form is considered to fulfill the response requirements of the last Office action. Applicant is not relieved from providing a separate record of the interview, unless box 1 above is also checked.

Examiner Note: You must sign this form unless it is an attachment to another form.

FORM PTOL-413 (REV. 1-95)

Handwritten signature

Manual of Patent Examining Procedure, Section 712.04 Substance of Interview must Be Made of Record

A complete written statement as to the substance of any face-to-face or telephone interview with regard to an application must be made of record in the examination, whether or not an agreement with the examiner was reached at the interview.

§1.133 Interviews

(b) In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for response in Office action as specified in §§ 1.111, 1.136. (35 U.S.C. 132)

§ 1.2. Business to be transacted in writing. All business with the Patent and Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete a two-sheet carbon imprinted Interview Summary Form for each interview held after January 1, 1978 where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks to read handwritten form using a ball point pen. Discussions regarding only procedural matters, devoted solely to restriction requirements for which interview reconsideration is otherwise provided for in Section 812.04 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the file, are excluded from the interview reconsideration procedures below.

The Interview Summary Form shall be given an appropriate paper number, placed in the right hand portion of the file, and listed on the "Contents" list on the file wrapper. The sheet and serial register cards need not be updated to reflect interviews. In a personal interview, the duplicate copy of the Form is removed and given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephonic interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not filed before an allowance or if other circumstances dictate, the Form should be mailed promptly after the telephonic interview rather than with the next official communication.

The Form provides for recording of the following information:

- Serial Number of the application
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (personal or telephonic)
- Name of participant(s) (applicant, attorney or agent, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the claims discussed
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). (Agreements as to allowability are tentative and do not restrict further action by the examiner in the majority.)
- The signature of the examiner who conducted the interview
- Names of other Patent and Trademark Office personnel present.

The Form also contains a statement reminding the applicant of his responsibility to record the substance of the interview.

It is desirable that the examiner fully remind the applicant of his obligation to record the substance of the interview in each case unless both applicant and examiner agree that the examiner will record same. Where the examiner agrees to record the substance of the interview or when it is adequately recorded on the Form or in an attachment to the Form, the examiner should check a box at the bottom of the Form informing the applicant that he need not supplement the Form by submitting a separate report of the substance of the interview.

It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted.
- 2) An identification of the claims discussed.
- 3) An identification of specific prior art discussed.
- 4) An identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the examiner.
- 5) A brief identification of the general thrust of the principal arguments presented to the examiner. The identification of arguments need not be lengthy if elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature, or thrust of the principal arguments made to the examiner can be understood from context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he feels were or might be persuasive to the examiner.
- 6) A personal indication of any other pertinent matters discussed, and
- 7) If appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete or accurate, the examiner will give the applicant one month from the date of the mailing letter or the remainder of any period for response, whichever is longer, to complete the response and thereby avoid abandonment of the application (37 CFR 1.135(c)).

Examiner to Check for Accuracy

Applicant's summary of what took place at the interview should be carefully checked to determine the accuracy of any argument or statement attributed to the examiner during the interview. If there is an inaccuracy and it bears directly on the question of patentability, it should be pointed out in the next Office letter. If the claims are allowable for other reasons of record, the examiner should send a letter giving both his or her version of the statement attributed to him. If the record is complete and accurate, the examiner should place the indication "Interview record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Application No. 08/845,657
Page 2

replace "alterative" with --alternative--.

Page 4, line 10

replace "axio-lateral" with --axio-laterally--.

Page 16, line 19

after "way" insert --to--.

Page 17, line 11

replace "Reinforcement" with --reinforcement--.

In the Claims

Please cancel claims 2,

Please amend the claims as follows:

1. (Amended) A stent in a non-expanded state, comprising:

a first expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the first expansion strut pair that couples the first and second expansion struts at a distal end of the first expansion strut pair, a plurality of the first expansion strut pair forming a first expansion column;

a second expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the second expansion strut pair that couples the first and second expansion struts of the second expansion strut pair at a proximal end of the second expansion strut pair, a plurality of the second expansion strut pair forming a second expansion column;

a first connecting strut including a first connecting strut proximal section, a first connecting strut distal section and a first connecting strut intermediate section, the first connecting strut proximal section being coupled to the distal end of the first expansion strut pair in the first expansion column and the first connecting strut distal section being coupled to the proximal end of the second expansion strut pair of the second expansion column, a plurality of the first connecting strut forming a first connecting strut column that couples the first expansion column to the second expansion column, ~~wherein a length of the first connecting strut proximal section [is] being equal to a length of the first connecting strut distal section, and a length of the first connecting strut intermediate section [is] being greater than the length of the first connecting strut proximal and distal sections, wherein the first expansion strut of the first expansion strut pair in the first expansion column has a longitudinal axis offset from a longitudinal axis of the first expansion strut of the second expansion strut pair in the second expansion column.~~

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Attorney Docket No. 18461-709

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Jang

Application No. 08/845,657

Filed: April 25, 1997

For: INTRAVASCULAR STENT

Group Art Unit: 3308

Examiner: Nguyen, T.

RECEIVED

JUN 1 1998

GROUP 3200

AMENDMENTAssistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This is in response to the Office Action mailed January 27, 1998,
submitted on or before the current due date of June 27, 1998.

Applicant petitions the Commissioner for an extension of time of two
months, from April 27, 1998 to June 27, 1998. The Commissioner is authorized to
charge Deposit Account No. 23-2415 (18461-709) the amount of \$200.00 for a
two month extension of time for a small entity.

Applicant's attorney thanks Examiners Nguyen and Willse for the many
courtesies extended during the interview conducted on June 5, 1998.

In the Specification

Please amend the specification as follows:

Page 1, line 8

replace "_____", (Attorney Docket No. 17828.707)* with -
08/824,142--.

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Application No. 08/845,657
Page 2

Page 1, line 10

replace "_____ (Attorney Docket No. 17828.708)" with --
08/824,866--.

Page 1, lines 12-13

replace "_____ (Attorney Docket No. 17828.709)" with --
08/824,865--.

Page 1, lines 14-15

replace "_____ (Attorney Docket No. 17828.708)" with --
08/845,734--.

Page 1, line 27

replace "alterative" with --alternative--.

Page 4, line 10

replace "axio-lateral" with --axio-laterally--.

Page 16, line 19

after "way" insert --to--.

Page 17, line 11

replace "Reenforcement" with --reenforcement--.

In the Claims

Please cancel claim 2.

Please amend the claims as follows:

1. (Amended) A stent in a non-expanded state, comprising:

a first expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the first expansion strut pair that couples the first and second expansion struts at a distal end of the first expansion strut pair, a plurality of the first expansion strut pair forming a first expansion column;

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Application No. 08/845,657
Page 3

a' *cancel.*
a second expansion strut pair including a first expansion strut positioned adjacent to a second expansion strut and a joining strut of the second expansion strut pair that couples the first and second expansion struts of the second expansion strut pair at a proximal end of the second expansion strut pair, a plurality of the second expansion strut pair forming a second expansion column;

a first connecting strut including a first connecting strut proximal section, a first connecting strut distal section and a first connecting strut intermediate section, the first connecting strut proximal section being coupled to the distal end of the first expansion strut pair in the first expansion column and the first connecting strut distal section being coupled to the proximal end of the second expansion strut pair of the second expansion column, a plurality of the first connecting strut forming a first connecting strut column that couples the first expansion column to the second expansion column, [wherein a length of the first connecting strut proximal section is equal to a length of the first connecting strut distal section, and a length of] the first connecting strut intermediate section [is] being non-parallel to [greater than the length of] the first connecting strut proximal and distal sections, wherein the first expansion strut of the first expansion strut pair in the first expansion column has a longitudinal axis offset from a longitudinal axis of the first expansion strut of the second expansion strut pair in the second expansion column.

2/3. (Amended) The stent of claim 1, wherein a spacing distance between the first expansion [column] strut pair and an adjacent first expansion [column] strut pair in the first expansion column are the same.

3/4. (Amended) The stent of claim 1, wherein a spacing distance between the second [column] expansion strut pair and an adjacent second [column] expansion strut pair in the second expansion column are different.

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Application No. 08/845,657
Page 4

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5. (Amended) The stent of claim 1, wherein a spacing distance between the first expansion [column] strut pair and an adjacent first expansion [column] strut pair in the first expansion column, and a spacing distance between the second [column] expansion strut pair and an adjacent second [column] expansion strut pair in the second expansion column are the same.

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6. (Amended) The stent of claim 1, wherein a spacing distance between the first expansion [column] strut pair and an adjacent first expansion [column] strut pair in the first expansion column, and a spacing distance between the second [column] expansion strut pair and an adjacent second [column] expansion strut pair in the second expansion column are different.

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7. (Amended) A stent in a non-expanded state, comprising:
a first expansion column formed of a plurality of first expansion column strut pairs, a first expansion strut pair including a first expansion strut adjacent to a second expansion strut and a first joining strut that couples the first and second expansion struts at a proximal end of the first expansion strut pair, a second expansion strut pair including a third expansion strut adjacent to the second expansion strut and a second joining strut that couples the second and third expansion struts at a distal end of the second expansion strut pair, a third expansion strut pair including a fourth expansion strut adjacent to the third expansion strut and a third joining strut that couples the third and fourth expansion struts at a proximal end of the third expansion strut pair, a fourth expansion strut pair including a fifth expansion strut adjacent to the fourth expansion strut and a fourth joining strut that couples the fourth and fifth expansion struts at a distal end of the fourth expansion strut pair, a first expansion strut pair first corner formed where the first joining strut is coupled to the first expansion strut, and a first expansion strut pair second corner formed where the first joining strut is coupled

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Page 5

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to the second expansion strut, and a second expansion strut pair first corner formed where the second joining strut is coupled to the second expansion strut, and a second expansion strut pair second corner formed where the second joining strut is coupled to the third expansion strut, and a third expansion strut pair first corner formed where the third joining strut is coupled to the third expansion strut, and a third expansion strut pair second corner formed where the third joining strut is coupled to the fourth expansion strut, and a fourth expansion strut pair first corner formed where the fourth joining strut is coupled to the fourth expansion strut, and a fourth expansion strut pair second corner formed where the fourth joining strut is coupled to the fifth expansion strut;

a second expansion column formed of a plurality of second expansion column strut pairs, a first expansion strut pair including a first expansion strut adjacent to a second expansion strut and a first joining strut that couples the first and second expansion struts at a proximal end of the first expansion strut pair, a second expansion strut pair including a third expansion strut adjacent to the second expansion strut and a second joining strut that couples the second and third expansion struts at a distal end of the second expansion strut pair, a third expansion strut pair including a fourth expansion strut adjacent to the third expansion strut and a third joining strut that couples the third and fourth expansion struts at a proximal end of the third expansion strut pair, a fourth expansion strut pair including a fifth expansion strut adjacent to the fourth expansion strut and a fourth joining strut that couples the fourth and fifth expansion struts at a distal end of the fourth expansion strut pair, a first expansion strut pair first corner formed where the first joining strut is coupled to the first expansion strut, and a first expansion strut pair second corner formed where the first joining strut is coupled to the second expansion strut, and a second expansion strut pair first corner formed where the second joining strut is coupled to the second expansion strut, and a second expansion strut pair second corner formed where the second joining

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Application No. 08/845,657
Page 6

strut is coupled to the third expansion strut, and a third expansion strut pair first corner formed where the third joining strut is coupled to the third expansion strut, and a third expansion strut pair second corner formed where the third joining strut is coupled to the fourth expansion strut, and a fourth expansion strut pair first corner formed where the fourth joining strut is coupled to the fourth expansion strut, and a fourth expansion strut pair second corner formed where the fourth joining strut is coupled to the fifth expansion strut; and

As
incl.

a first connecting strut column formed of a plurality of first connecting struts, each connecting strut of the first connecting strut column including a connecting strut proximal section, a connecting strut distal section and a connecting strut intermediate section, a first connecting strut proximal section is coupled to the joining strut of the second expansion strut pair of the first expansion strut column, and a first connecting strut distal section is coupled to the joining strut of the first expansion strut pair of the second expansion strut column, and a second connecting strut proximal section is coupled to the joining strut of the fourth expansion strut pair of the first expansion strut column, and a second connecting strut distal section is coupled to the joining strut of the third expansion strut pair of the second expansion strut column, [wherein a length of the connecting strut proximal section is the same as a length of the connecting strut distal section and the connecting strut intermediate section has a length that is greater than the lengths of the connecting strut distal and proximal sections], the first connecting strut intermediate section being non-parallel to the first connecting strut proximal and distal sections, wherein the first expansion strut of the first expansion strut pair in the first expansion column has a longitudinal axis offset from a longitudinal axis of the first expansion strut of the second expansion strut pair in the second expansion column.

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Page 7

REMARKS

The Examiner has objected to the disclosure because of informalities and typographical errors, and requires correction. The Examiner has also objected to dependent claims 3-6 because of informalities and requires correction. Applicant has amended the specification and claims 3-6 to overcome these grounds of objection.

Applicant thanks the Examiner for his indication that claims 4, 6, 19, 20, 22, 23, 31-38, 46-47, 51, 59, 63, 65, 74-75, 77-78 and 80-86 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 1-3, 5, 7-18, 21, 24-30, 39-45, 48-50, 52-58, 60-62, 64, 66-73, 76 and 79 have been rejected under 35 U.S.C. § 102(b) as anticipated by EP 079067A2 ("Pinchasik, et al."). Claims 13-15 stand rejected under 35 U.S.C. § 103 as being obvious over Pinchasik, et al. in view of EP 0679372A2 ("Lam, et al."). These grounds of rejection are respectively traversed.

The present invention is a stent with a first connecting strut with proximal, distal and intermediate sections. The intermediate section is non-parallel to the proximal and distal sections. Additionally, the stent has a first expansion strut of a first expansion strut pair in a first expansion column that has a longitudinal axis which is offset from a longitudinal axis of a first expansion strut of the second expansion strut pair in a second expansion column.

Pinchasik et al., fails to teach or suggest such a structure. Pinchasik et al., in combination with Lam et al., also fails to teach or suggest such a structure. Additionally, there is no suggestion or motivation to combine the teachings of Pinchasik et al., with Lam et al. to obtain the stent of the present invention.

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Application No. 08/845,657
Page 8

CONCLUSION

Applicant believes that the application is now in condition for allowance
and respectfully requests issuance of a notice of allowance.

Respectfully submitted,

WILSON SONSINI GOODRICH & ROSATI

Date:

6/17/98

By:



Paul Davis, Reg. No. 29,294

650 Page Mill Road
Palo Alto, California 94304
(415) 493-9300

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Please type a plus sign (+) inside this box ☐Approved for use through
Patent and Trademark Office, U.S. I.PTO/SB/21 (12-97)
SAC, OMB 0851-0051
DEPARTMENT OF COMMERCE

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TRANSMITTAL FORM (to be used for all correspondence after initial filing)	Application Number	08/845,657
	Filing Date	04/25/97
	First Named Inventor	Jang
	Group Art Unit	3308
	Examiner Name	Nguyen, T.
Total Number of Pages in This Submission	Attorney Docket Number	18461-709

ENCLOSURES

<input checked="" type="checkbox"/> Fee Transmittal Form	Assignment Papers (for an Application)
<input checked="" type="checkbox"/> Authorization to Charge Deposit Account Attached	Drawing(s)
<input checked="" type="checkbox"/> Amendment/Response	Revocation and Power of Attorney by Assignee
<input type="checkbox"/> After Final	Petition Rolling Slip (PTO/SB/60) and Accompanying Petition
<input type="checkbox"/> Affidavits/declarations	To Convert a Provisional Application
<input checked="" type="checkbox"/> Extension of Time Request	Declaration of Inventor(s)
<input type="checkbox"/> Express Abandonment Request	Terminal Disclaimer
<input type="checkbox"/> Information Disclosure Statement	Small Entity Statement
<input type="checkbox"/> Certified Copy of Priority Document(s)	Request for Corrected Filing Receipt
<input type="checkbox"/> Response to Missing Parts under 37 CFR 1.62 or 1.63	After Allowance Communication to Group
	Appeal Communication to Board of Appeals and Interferences
	Appeal Communication to Group (Appeal Notice, Brief, Reply Brief)
	Proprietary Information
	Status Letter
	Additional Enclosure(s) (please identify below):
	Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or individual name	PAUL D. WILSON, REG. NO. 29,294, WILSON SOMMER GOODPICH & ROSATI
Signature	Date 6/17/98

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first class mail to: Assistant Commissioner for Patents, Washington, D.C. 20231, on		Date	6/17/98
Typed or printed name	Jeffrey R. Howard		
Signature	Jeffrey R. Howard	Date	6/17/98

Burden Your Statement: This form is estimated to take 12 minutes to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

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FEE TRANSMITTAL		Complete if Known	
Note: Effective October 1, 1997, Patent fees are subject to annual revision.		Application Number	23-2415
TOTAL AMOUNT OF PAYMENT \$200		Filing Date	04/25/97
METHOD OF PAYMENT (check one)		Firm/Inventor	Jang
1. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge indicated fee and credit any over payments to:		Class/Art Unit	3508
Deposit Account Number 23-2415 (18461-709)		Examiner Name	Nguyen, T.
Deposit Account Name Wilson Sorsini Goodrich & Rosati		Attorney/Deputy Number	18461-709
2. <input checked="" type="checkbox"/> Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17		FEE CALCULATION (continued)	
3. <input checked="" type="checkbox"/> Payment Enclosed: <input type="checkbox"/> Check <input type="checkbox"/> Money Order <input checked="" type="checkbox"/> Other		3. ADDITIONAL FEES	
FEE CALCULATION		Large Entity Small Entity	
1. FILING FEE		Fee Code (\$)	
Large Entity Fee Code (\$)		Fee Description	
101 790 201 395 Utility filing fee		105 130 205 65 Surcharge - late filing fee or oath	
106 330 206 165 Design filing fee		127 50 227 25 Surcharge - late provisional filing fee or cover sheet	
107 540 207 270 Plant filing fee		139 130 139 130 Non-English specification	
108 790 208 395 Reissue filing fee		147 2,520 147 2,520 For filing a request for reexamination	
114 150 214 75 Provisional filing fee		112 920 112 920 Requesting publication of SIR prior to Examiner action	
SUBTOTAL (1) (\$)		113 1,840 113 1,840 Requesting publication of SIR after Examiner action	
2. CLAIMS		115 110 215 55 Extension for reply within first month	
Total Claims - 20 =		118 400 216 200 Extension for reply within second month	
Independent Claims - 3 =		117 950 217 475 Extension for reply within third month	
Multiple Dependent Claims		116 1,510 218 735 Extension for reply within fourth month	
Large Entity Fee Code (\$)		128 2,060 228 1,030 Extension for reply within fifth month	
103 22 203 11 Claims in excess of 20		119 310 219 155 Notice of Appeal	
102 82 202 41 Independent claims in excess of 3		120 310 220 155 Filing a brief in support of an appeal	
104 270 204 135 Multiple dependent claim		121 270 221 135 Request for oral hearing	
109 82 209 41 Reissue independent claims over original patent		138 1,510 138 1,510 Petition to institute a public use proceeding	
110 22 210 11 Reissue claims in excess of 20 and over original patent		140 110 240 55 Petition to revive - unavoidable	
SUBTOTAL (2) (\$)		141 1,320 241 660 Petition to revive - unintentional	
SUBMITTED BY		142 1,320 242 660 Utility issue fee (or release)	
Type of Printed Name PAUL DAVIS		143 450 243 225 Design issue fee	
Signature [Signature]		144 670 244 335 Plant issue fee	
Date 4/17/97		122 130 122 130 Petition to the Commissioner	
Reg. Number 28,294		123 50 123 50 Petitions related to provisional applications	
Deposit Account 23-2415		126 240 126 240 Submission of Information Disclosure Sheet	
User ID 0		581 40 581 40 Recording each patent assignment per property (lines number of properties)	
		146 790 246 395 Filing a submission after final rejection (37 CFR 1.120(a))	
		148 790 249 395 For each additional invention to be examined (37 CFR 1.120(b))	
		Other fee (specify) 25 Retest for Corrected Filing Receipt	
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Patent and Trademark Office

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APPLICATION NO.	FILED DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/045,057	04/26/97	JANG	18461.709

PAUL DAVIS
WILSON SONSINI GOODRICH & ROSATI
650 PAGE MILL ROAD
PALO ALTO CA 94304-1050

QM31/0915

EXAMINER
NGUYEN, T

ART UNIT
3738

PAPER NUMBER

DATE MAILED: 09/15/98

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

PTO-30C (REV. 2/96)

U.S. GOVERNMENT PRINTING OFFICE 1995-319-326

1-File Copy

JFH 000213

Office Action Summary		Application No. 08/845,657	Applicant(s) JANG
		Examiner Tara Nguyen	Group Art Unit 3738

☒ Responsive to communication(s) filed on Jun 22, 1998

☒ This action is FINAL.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) 1-86 is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 1-86 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been received.

☐ received in Application No. (Series Code/Serial Number) _____

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

U. S. Patent and Trademark Office
PTO-326 (Rev. 9-95)

Office Action Summary

Part of Paper No. 8

Application/Control Number: 08/845,657
Art Unit: 3738

Page 2

Specification

1. In response to applicant's amendment of June 22, 1998, the examiner has withdrawn all prior objections to the specification.

Claim Objections

2. In response to applicant's amendment of June 22, 1998, the examiner has withdrawn all prior objections to the claims.

Double Patenting

3. Claims 1 and 24 of this application conflict with claims 1, 2, 4, 5, and 49 of Application No. 08/824,142. 37 CFR 1.78(b) provides that when two or more applications filed by the same applicant contain conflicting claims, elimination of such claims from all but one application may be required in the absence of good and sufficient reason for their retention during pendency in more than one application. Applicant is required to either cancel the conflicting claims from all but one application or maintain a clear line of demarcation between the applications. See MPEP § 822.
4. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686

Application/Control Number: 08/845,657
 Art Unit: 3738

Page 3

F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

5. Claims 1 and 24 are provisionally rejected under the judicially created doctrine of double patenting over claims 1, 2, 4, 5, and 49 of copending Application No. 08/824,142. This is a provisional double patenting rejection since the conflicting claims have not yet been patented.

The subject matter claimed in the instant application is fully disclosed in the referenced copending application and would be covered by any patent granted on that copending application since the referenced copending application and the instant application are claiming common subject matter, as follows:

This application claims a first expansion column comprising a plurality of expansion strut pairs, a second expansion column comprising a plurality of second column expansion strut pairs, a first connecting strut column comprising struts which connect the first column expansion strut pairs to the second column expansion strut pairs, and a second connecting strut column comprising connecting struts which connect the second column expansion strut pairs to a third

Application/Control Number: 08/845,657
Art Unit: 3738

Page 4

expansion column, wherein the expansion strut pairs of the first expansion column are longitudinally offset from the expansion strut pairs of the second expansion column.

Application No. 08/824,142 claims a first expansion column comprising a plurality of expansion strut pairs, each first expansion strut pair defining a first column loop slot, a second expansion column comprising a plurality of second column expansion strut pairs, each second expansion strut pair defining a second column loop slot, a first connecting strut column comprising struts which connect the first column expansion strut pairs to the second column expansion strut pairs, and a second connecting strut column comprising connecting struts which connect the second column expansion strut pairs to a third expansion column, wherein the first column loop slots are non-parallel or non-collinear to the second column loop slots. The application also claims that the first expansion strut in the first expansion column is circumferentially offset from a corresponding second expansion strut of the second expansion column.

Furthermore, there is no apparent reason why applicant would be prevented from presenting claims corresponding to those of the instant application in the other copending application. See *In re Schneller*, 397 F.2d 350, 158 USPQ 210 (CCPA 1968). See also MPEP § 804.

Response to Arguments

6. Applicant's arguments with respect to claims 1-86 have been considered but are moot in view of the new ground(s) of rejection.

Application/Control Number: 08/845,657
Art Unit: 3738

Page 5

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.


Application/Control Number: 08/845,657
Art Unit: 3738


Page 6

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tram Nguyen whose telephone number is (703) 308-0804. The examiner can normally be reached on Monday - Friday from 9:00 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mickey Yu, can be reached at (703) 308-2672. The fax phone number for this group is (703) 305-3590.

Any inquiry of a general nature or relating to the status of this application or proceedings should be directed to the group receptionist whose telephone number is (703) 308-0858.


TAN
September 13, 1998


MICHAEL J. MILANO
PRIMARY EXAMINER
ART UNIT 3738

**CERTIFICATE OF MAILING**

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231, on 9/4/98

Michelle E. Grossin
Michelle E. Grossin

3308
\$ 3785

9-16
IDS/#9
Tina
PATENT 10-2199

Attorney Docket No. 18461.709

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**In re Application**

Inventor(s): G. David Jang
Application No.: 08/845,657
Filed: April 25, 1997
Title: INTRAVASCULAR STENT

PATENT APPLICATION

Art Unit: 3308
Examiner: Nguyen, T.

RECEIVED
SEP 11 1998

INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. 61.91

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Listed below or on an attached Form PTO-1449 is information known to applicant(s). Due to the large number of references and since these same references are being cited on many applications, only one copy of each listed publication and U.S. and foreign patent, except for pending U.S. applications, is being submitted along with a concise explanation of information in a foreign language, if any, pursuant to 37 C.F.R. §1.97-1.98. The references are being submitted concurrent with this information disclosure statement in application serial number 08/642,053, which is a prior application to this application. An additional copy of these references will be supplied upon request.

Applicants respectfully request that the listed information be considered by the Examiner and be made of record in the above-identified application. If form PTO-1449 is enclosed, the Examiner is requested to initial and return it in accordance with MPEP §609.

This statement is not intended to represent that a search has been made or that the information cited in the statement is, or is considered to be, material to patentability as defined in §1.56.

==ODMAVPCDOCSISQL26213181

- 1 -

— This statement qualifies under 37 C.F.R. §1.97, subsection (b) because (check all that apply):

- (1) It is being filed within 3 months of the application filing date
— OR —
- (2) It is being filed within 3 months of entry of a national stage
— OR —
- (3) It is being filed before the mail date of the first Office Action on the merits.

X 37 C.F.R. §1.97(c). If this statement is being filed after the latest of: (1) three months beyond the filing date of a national application; (2) three months beyond the date of entry of the national stage as set forth in §1.491 in an international application; or (3) the mailing date of a first Office action on the merits, but before the mailing date of the earlier of a final office action under §1.113 or a notice of allowance under §1.311, then:

— a certification as specified in §1.97(e) is provided below; or

X a fee of \$240.00 as set forth in §1.17(p) is authorized below, enclosed, or included with the payment of other papers filed together with this statement.

— 37 C.F.R. §1.97(d). If this statement is being filed after the mailing date of the earlier of a final office action under §1.113 or a notice of allowance under §1.311, but before payment of the issue fee, then:

A. a certification as specified in §1.97(e) is completed below; and

B. a petition under 37 C.F.R. §1.97(d) requesting consideration of this statement is submitted herewith; and

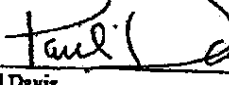
C. a fee of \$130.00 as set forth in §1.17(i)(1) is authorized below, enclosed, or included with the payment of other papers filed together with this statement.

X Fee Authorization. The Commissioner is hereby authorized to charge underpayment of any additional fees or credit any overpayment associated with this communication to Deposit Account No. 23-2415 (Docket No. 18461.709). A duplicate copy of this authorization is enclosed.

Respectfully submitted,

WILSON SONSINI GOODRICH & ROSATI

Date: 9/4/98

By: 
Paul Davis
Reg. No. 4704

650 Page Mill Road
Palo Alto, CA 94304-1050
(650) 493-9300

ODMA\PCDOCS\SQL26213881



SHEET 1 OF 1

INFORMATION DISCLOSURE CITATION				ATTY. DOCKET NO. 18481.709		APPLICATION NO. 08/845,857	
PTO-1449				TITLE INTRAVASCULAR STENT			
				APPLICANT G. David Jang			
				FILING DATE April 25, 1997		GROUP 8508 3736	
U.S. PATENT DOCUMENTS							
EXAMINER'S INITIALS	PATENT NO.	DATE	NAME	CLASS	SUBCLASS	FILING DATE	
TBM	5,776,183	7/8/98	Kanesake, et al.				
TBM	5,776,161	7/8/98	Globerman				
TBM	5,102,417	4/2/92	Palmaz				
FOREIGN PATENT DOCUMENTS							
EXAMINER'S INITIALS	PATENT NO.	DATE	COUNTRY	CLASS	SUBCLASS	Translation Yes No	
TBM	WO 97/40781	11/8/97	PCT				
TBM	WO 97/40780	11/8/97	PCT				
OTHER DOCUMENTS (including Abstracts, etc.)							
EXAMINER Tam Nguyen				DATE CONSIDERED 2/1/99			

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.



Practitioner's Docket No. 18461-709

AFI GAU 3738
#1
1-11-13
#10

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Jang, G. David
Serial No.: 08/845,657
Filed: 04/25/1997
For: Intravascular Stent

Group No.: 3738

Examiner: Nguyen, T

RECEIVED

OCT 19 1998

Group 3700

Assistant Commissioner for Patents
Washington, D.C. 20231

RESPONSE TRANSMITTAL

1. Transmitted herewith is a Terminal Disclaimer in response to the Office Action mailed 09/15/98.

STATUS

2. Applicant is a small entity. A small entity statement was previously submitted.

EXTENSION OF TERM

3. The proceedings herein are for a patent application and the provisions of 37 C.F.R. 1.136 apply. Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition for extension of time.

FEE FOR STATUTORY DISCLAIMER

4. The Commissioner is authorized to charge Account No. 23-2415 (18461-709) the amount of \$45.00 for the fee for submission of a terminal disclaimer by a small entity.

FEE DEFICIENCY

5. If any additional extension and/or fee is required, charge Account No. 23-2415 (18461-709).


PAUL DAVIS, REG. NO. 29,294

650 Page Mill Road
Palo Alto, CA 94304
(650) 493-9300

Fractlth'er's Docket No. 18461-709

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Jang, G. David
 Serial No.: 08/845,657
 Filed: 04/25/1997
 For: Intravascular Stent

Group No.: 3738
 Examiner: Nguyen, T.



Box AF
 Assistant Commissioner for Patents
 Washington, D.C. 20231

AMENDMENT OR RESPONSE AFTER FINAL REJECTION

Sir:

In response to the Final Office Action mailed 09/15/1998, applicant submits a Terminal Disclaimer to Obviate a Provisional Double Patenting Rejection over pending application Serial No. 08/824,142. It is submitted that the attached terminal disclaimer overcomes the provisional rejection based on a nonstatutory double patenting ground, as the applications involved are commonly owned by applicant.

Respectfully submitted,

WILSON SONSINI GOODRICH & ROSATI

Date: 10.6.98

Paul Davis, Reg. No. 29,294

650 Page Mill Road
 Palo Alto, CA 94304
 (650) 493-9300

CERTIFICATION UNDER 37 C.F.R. 1.8(a) and 1.10*
 (When using Express Mail, the Express Mail label number is mandatory.
 Express Mail certification is optional.)

I hereby certify that, on the date shown below, this correspondence is being:

MAILING

☐ deposited with the United States Postal Service in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

☒ 37 C.F.R. 1.8(a)
 with sufficient postage as first class mail.

☐ 37 C.F.R. 1.10*
 as "Express Mail Post Office to Address"
 Mailing Label No. _____ (mandatory)

TRANSMISSION

☐ transmitted by facsimile to the Patent and Trademark Office.

Date: October 6, 1998

Sidney Maschus

*WARNING:


Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. 1.10(b).
 "Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will not be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

(Amendment or Response after Final Rejection—Page 1)

104
1-14-99
F11

PATENT
Attorney Docket No. 1846-709

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	G. David Jang		PATENT APPLICATION
Serial No.:	08/845,657		Group: 3738
Filed:	4/25/97		Examiner: Nguyen, T.
Title:	Intravascular Stent		

**TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING REJECTION
OVER A PENDING SECOND APPLICATION**

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

G. David Jang, the owner of 100% interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application, which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 to 156 and 173, as presently shortened by any terminal disclaimer filed prior to the grant of any patent granted on commonly owned pending second Application No. 08/824,142, filed on 03/26/97. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the second application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 to 156 and 173 of any patent granted on the second application, as shortened by any terminal disclaimer filed prior to the patent grant, in the event that any such granted patent: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 C.F.R. 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer filed prior to its grant.


Check either box 1 or 2 below, if appropriate.

1. ☐ For submission on behalf of any organization (e.g., corporation, partnership, university, government agent, etc.), the undersigned is empowered to act on behalf of the organization.

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

2. ☒ The undersigned is an attorney of record.

10/16/1998 23000000 232415 08845657
01 FC20 55.00 CH

Respectfully submitted,
WILSON SONNEN GOODRICH & ROSATI

Paul Davis, Reg. No. 29,294

Date: _____
650 Page Mill Road
Palo Alto, California 94304
(415) 493-9300

☒ Charge Deposit Account 23-2415 the sum of \$ 45.00 for a small entity for the terminal disclaimer fee and for any fee deficiency.

☒ PTO suggested wording for terminal disclaimer was:

☐ unchanged ☒ changed (If changed, an explanation should be supplied. Explanation: Changed wording of fee payment to indicate Amount, Deposit Account, and Status of Grant.
Add the language "commonly owned" at line 4.

>*Certification under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee.<

PTO/SB/26

Notice of Allowability	Application No. 08/045,667	Applicant(s) JANG
	Examiner Tram Nguyen	Group Art Unit 3738

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance and Issue Fee Due or other appropriate communication will be mailed in due course.

☒ This communication is responsive to applicant's terminal disclaimer filed Oct. 13, 1998

☒ The allowed claim(s) is/are 1 and 3-86

☐ The drawings filed on _____ are acceptable.

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. [Series Code/Serial Number] _____

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE THREE MONTHS FROM THE "DATE MAILED" of this Office action. Failure to timely comply will result in ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.

☒ Applicant MUST submit NEW FORMAL DRAWINGS

☒ because the originally filed drawings were declared by applicant to be informal.

☒ including changes required by the Notice of Draftsperson's Patent Drawing Review, PTO-948, attached hereto or to Paper No. 5

☐ including changes required by the proposed drawing correction filed on _____, which has been approved by the examiner.

☐ including changes required by the attached Examiner's Amendment/Comment.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the reverse side of the drawings. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

☐ Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Any response to this letter should include, in the upper right hand corner, the APPLICATION NUMBER (SERIES CODE/SERIAL NUMBER). If applicant has received a Notice of Allowance and Issue Fee Due, the ISSUE BATCH NUMBER and DATE of the NOTICE OF ALLOWANCE should also be included.

Attachment(s)

☒ Notice of References Cited, PTO-892

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 9

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

☐ Interview Summary, PTO-413

☐ Examiner's Amendment/Comment

☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

☒ Examiner's Statement of Reasons for Allowance

U. S. Patent and Trademark Office
PTO-37 (Rev. 9-95)

Notice of Allowability

Part of Paper No. 12

Application/Control Number: 08/845,657
Art Unit: 3738

Page 2

Allowable Subject Matter

1. Claims 1 and 3-86 are allowed.
2. The application having been allowed, formal drawings are required in response to this Office action.
3. The following is an examiner's statement of reasons for allowance:

Applicant's terminal disclaimer, filed on October 13, 1998, satisfies the examiner's provisional double patenting rejection. Accordingly, all pending claims are deemed allowable over the prior art.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Tan
TAN
February 10, 1999


David H. Wilke
Primary Examiner

Notice of References Cited				Application No. 08/848,657		Applicant(s) JANG	
				Examiner Tram Nguyen		Group Art Unit 3738	
						Page 1 of 1	

U.S. PATENT DOCUMENTS					
#	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS
X A	5,810,872	9/1998	KANESAKA et al.	623	1
X B	5,824,058	10/1998	VIJAY	623	1
X C	5,838,984	11/1998	RICHTER et al.	623	1
D					
E					
F					
G					
H					
I					
J					
K					
L					
M					

FOREIGN PATENT DOCUMENTS						
#	DOCUMENT NO.	DATE	COUNTRY	NAME	CLASS	SUBCLASS
N						
O						
P						
Q						
R						
S						
T						

NON-PATENT DOCUMENTS	
#	DOCUMENT (including Author, Title, Source, and Filing Date)
U	
V	
W	
X	

* A copy of this reference is not being furnished with this Office action.
 (See Manual of Patent Examining Procedure, Section 707.05(a).)



UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office

NOTICE OF ALLOWANCE AND ISSUE FEE DUE

QM31/0218

PAUL DAVIS
WILSON SONSINI GOODRICH & ROSATI
650 PAGE MILL ROAD
PALO ALTO CA 94304-1050

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
08/845,657	04/25/97	085	NGUYEN, T	3738 02/18/
First Named Applicant	JANG,	35 USC 154(b) term ext. = 0 Days.		
TITLE OF INVENTION	INTRAVASCULAR STENT			

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPL. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
3	18461-769	623-001.000	P32 UTILITY	NO	\$1210.00	05/18/

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED.

THE ISSUE FEE MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED.

HOW TO RESPOND TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

- A. If the status is changed, pay twice the amount of the FEE DUE shown above and notify the Patent and Trademark Office of the change in status, or
- B. If the status is the same, pay the FEE DUE shown above.

If the SMALL ENTITY is shown as NO:

A. Pay FEE DUE shown above, or

B. File verified statement of Small Entity Status before, or with, payment of 1/2 the FEE DUE shown above.

II. Part B-Issue Fee Transmittal should be completed and returned to the Patent and Trademark Office (PTO) with your ISSUE FEE. Even if the ISSUE FEE has already been paid by charge to deposit account, Part B Issue Fee Transmittal should be completed and returned. If you are charging the ISSUE FEE to your deposit account, section "4b" of Part B-Issue Fee Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give application number and batch number.

Please direct all communications prior to issuance to Box ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PATENT AND TRADEMARK OFFICE COPY

PTOL-86 (REV. 10-86) Approved for use through 06/30/99. (0651-0033)

ma

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2-25-99 #13 L

Practitioner's Docket No. 18461-709

PATENT



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re application of: Jang, G. David
Serial No.: 08/845,657
Filed: 04/23/1997
For: Intravascular Stent

Group No. 3738
Examiner: Nguyen, T.
Batch No. P32

Assistant Commissioner for Patents
Washington, D.C. 20231

TRANSMITTAL OF FORMAL DRAWINGS

In response to the NOTICE OF ALLOWABILITY mailed on 2/18/1999, attached please find:

(a) the formal drawing(s) for this application.

Number of Sheets: 27

Respectfully submitted,

Paul Davis, Reg. No. 29,294

Wilson Sonsini Goodrich & Rosati
650 Page Mill Road
Palo Alto, CA 94304
(650) 493-9300

RECEIVED

APR 16 1999

Publishing Division
Comes/Allowed Files (07)

CERTIFICATE OF MAILING (37 C.F.R. 1.8(a))

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Date: 4-9-99

Sidney M. Bruson

(Transmittal of Formal Drawings—page 1 of 1)

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1/27

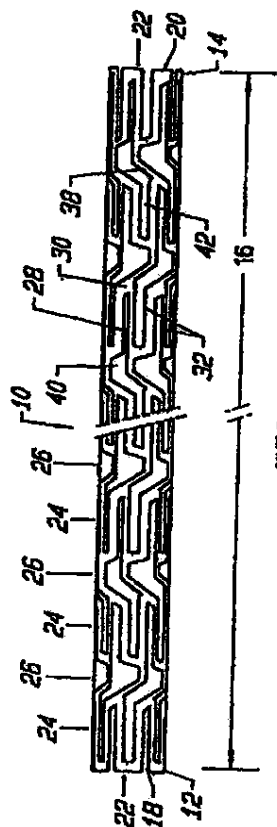


FIG. 1A

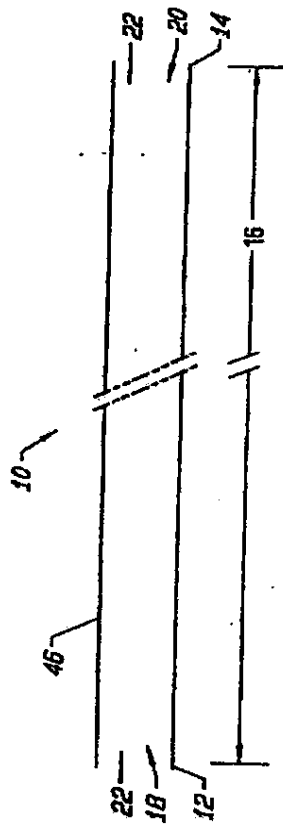


FIG. 1C

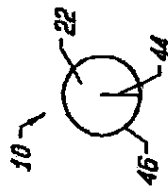


FIG. 1B

2/27

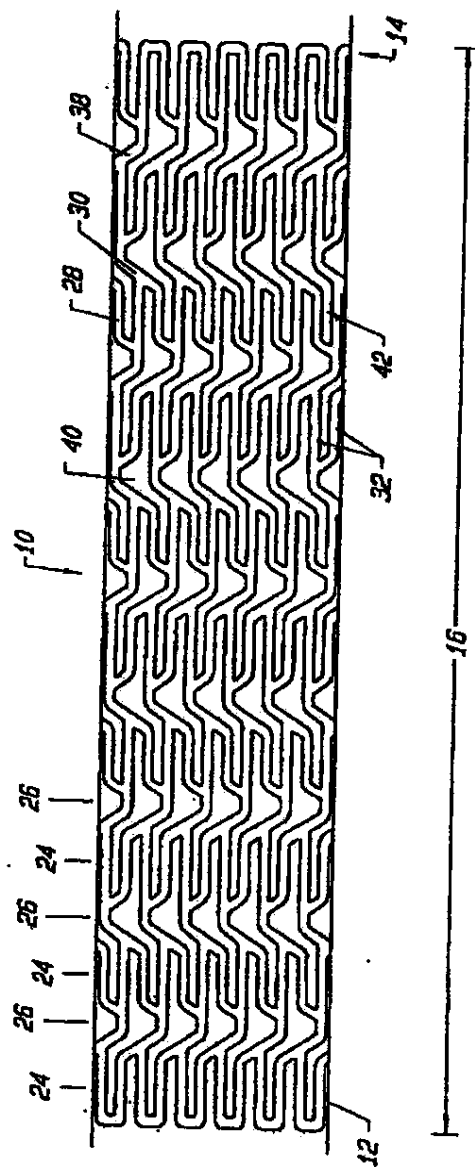


FIG. 2A

3/27

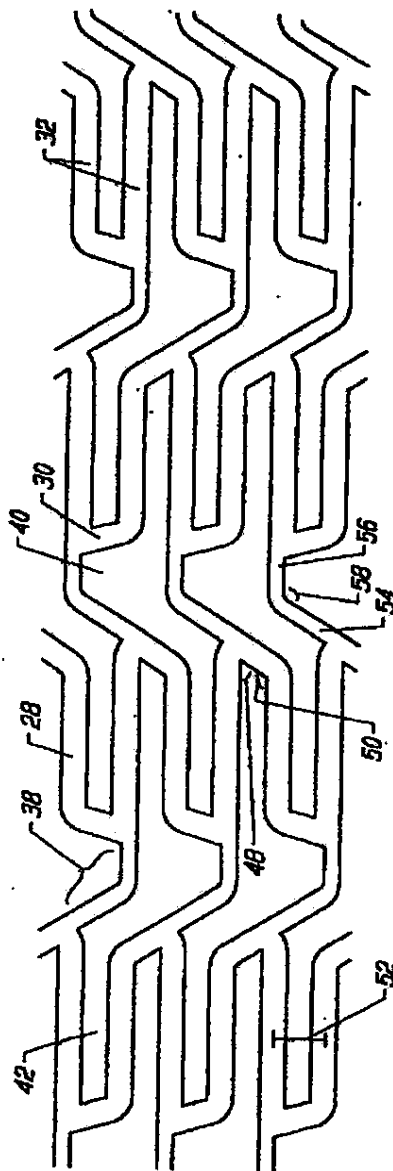


FIG. 2B

4/27

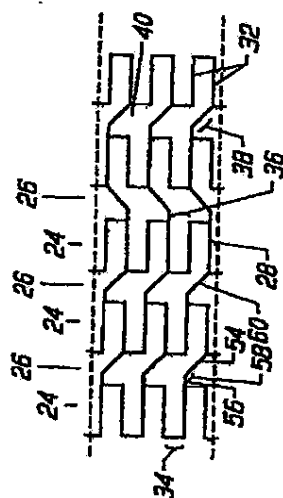


FIG. 3A

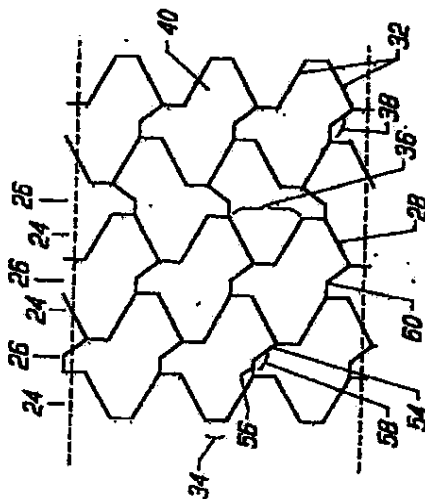
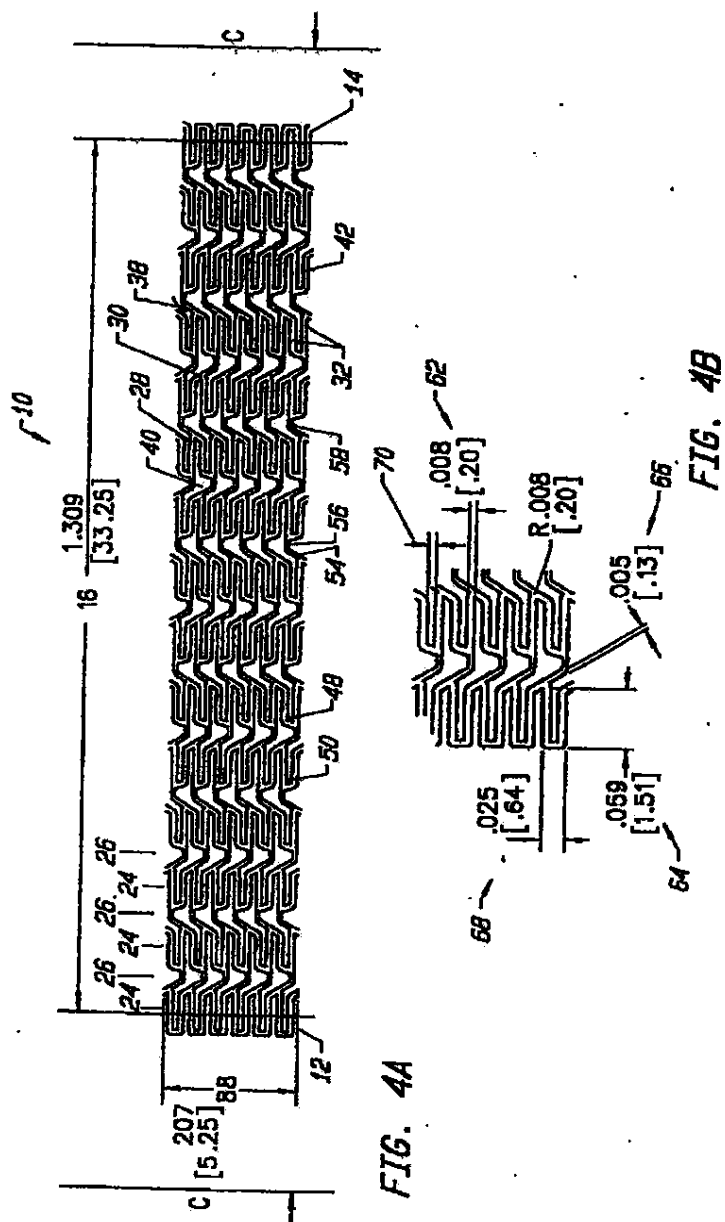
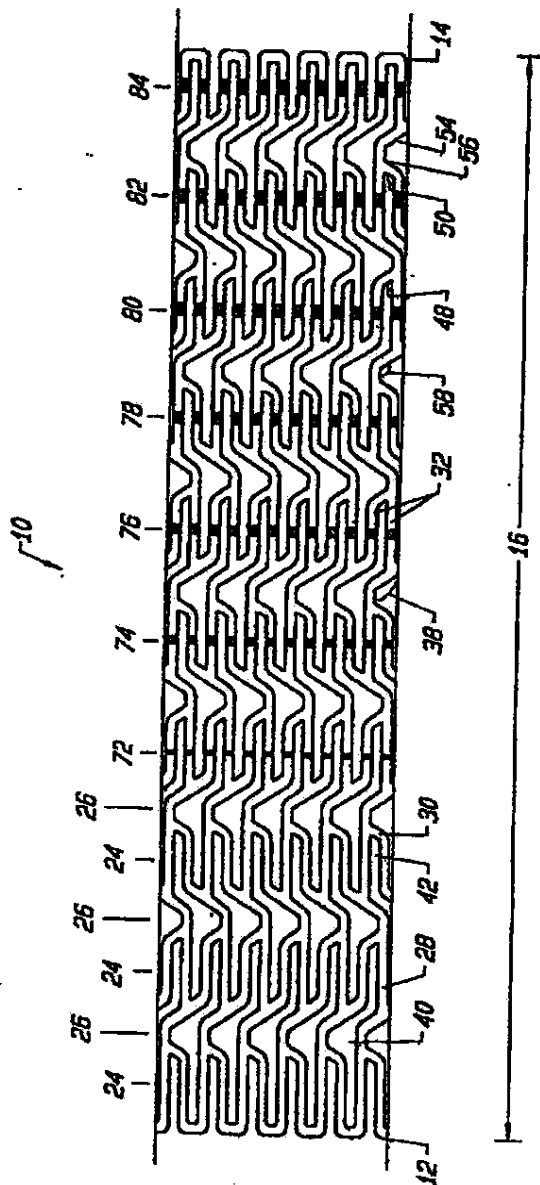


FIG. 3B

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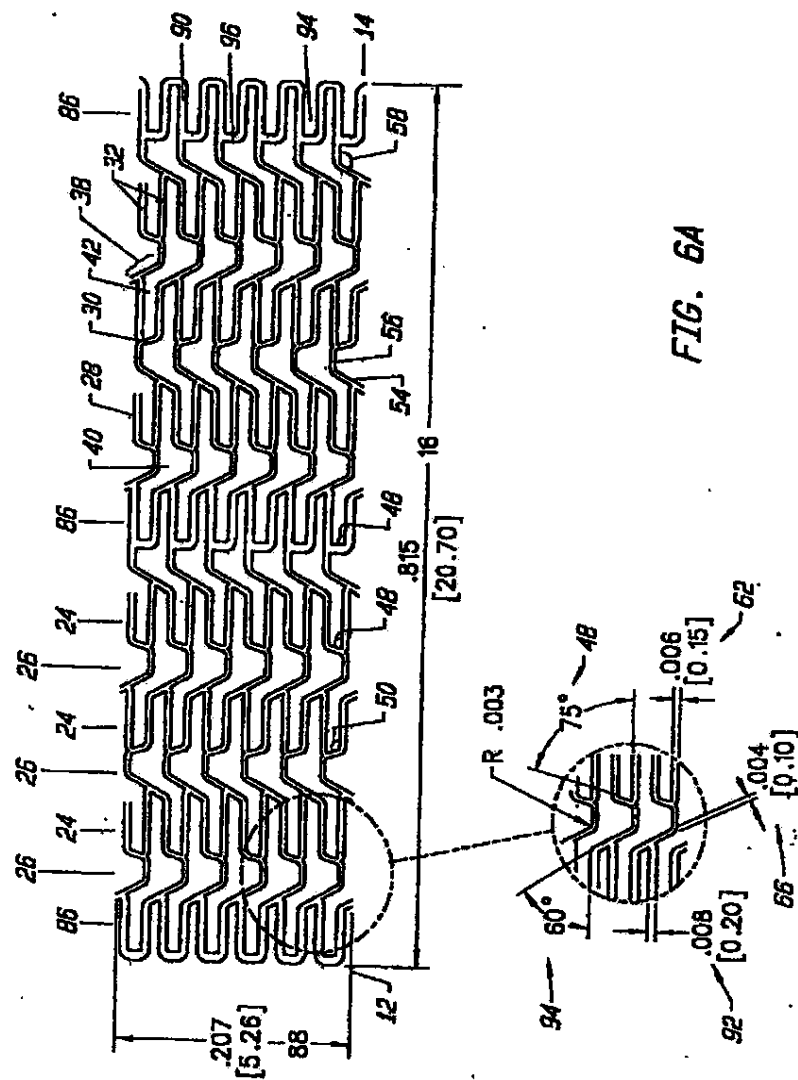


FIG. 6A

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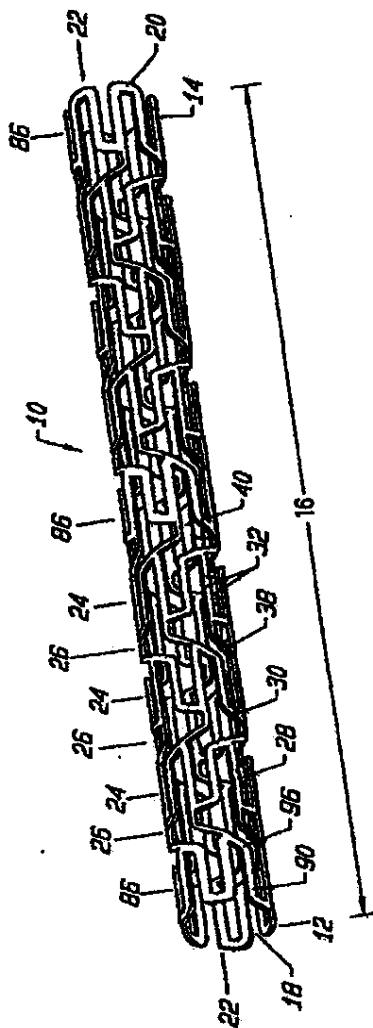


FIG. 68

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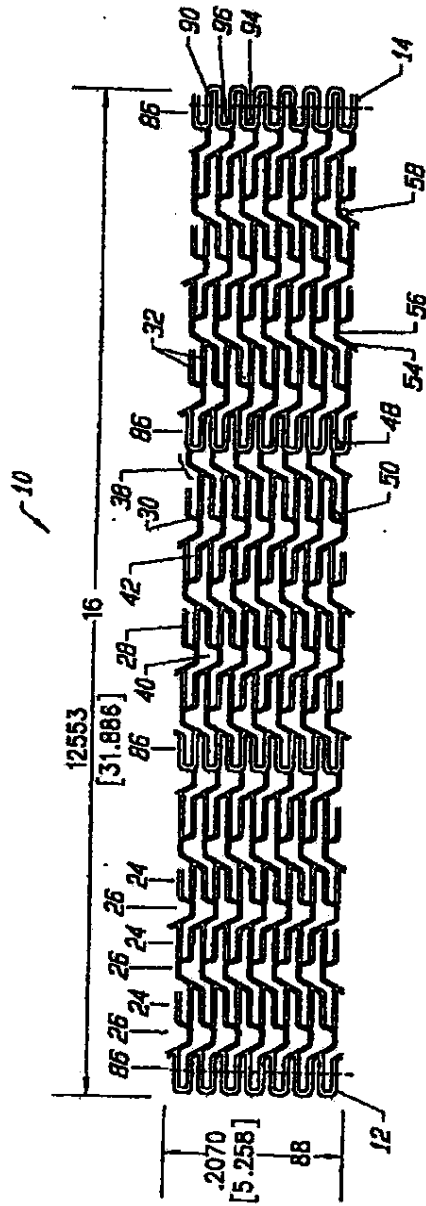


FIG. 7A

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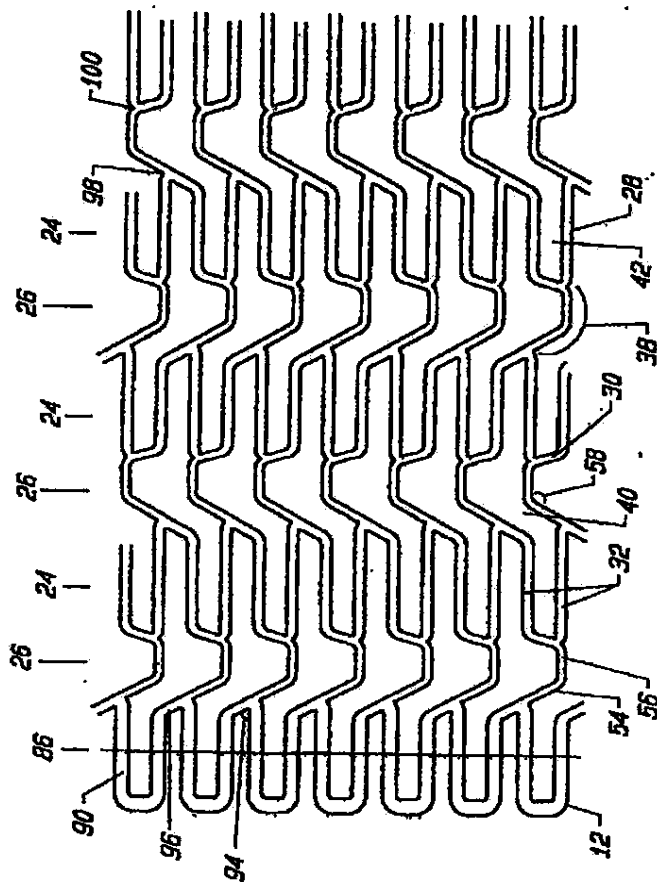


FIG. 7B

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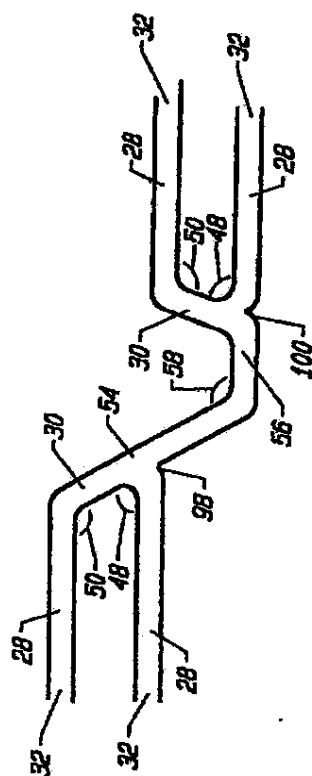
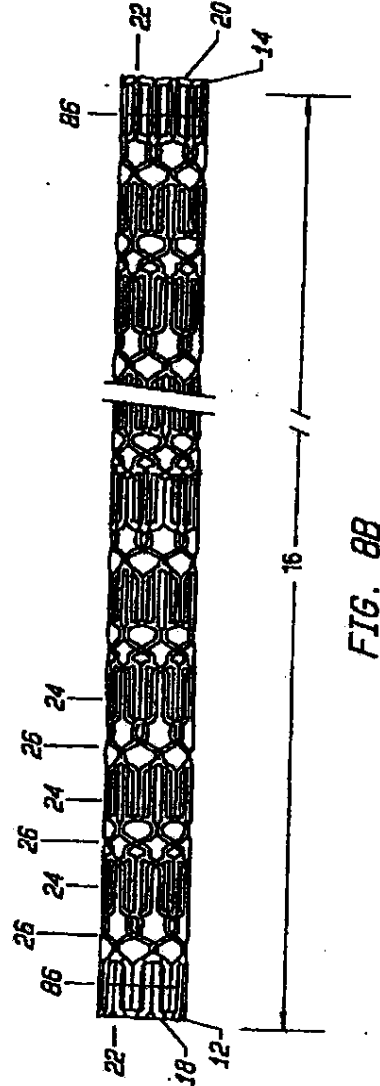
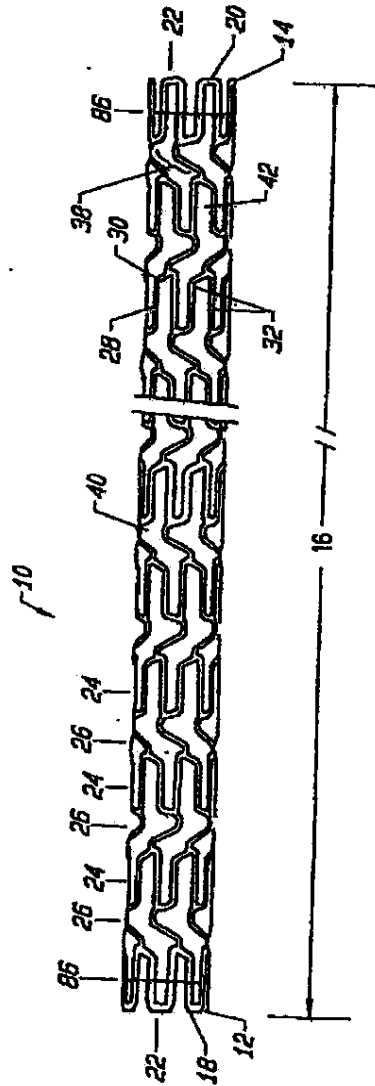


FIG. 7C

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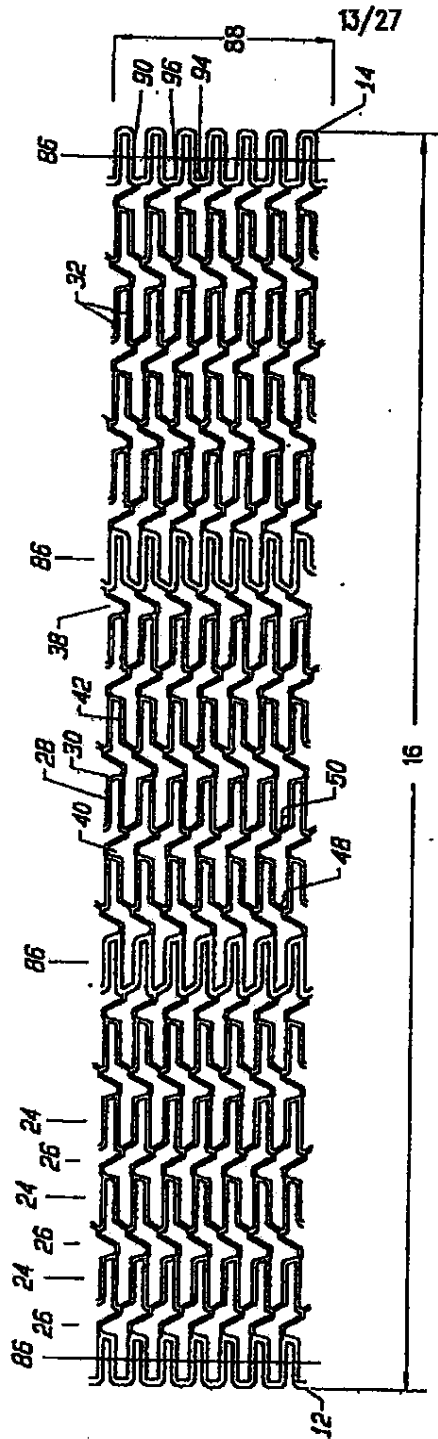


FIG. 8C

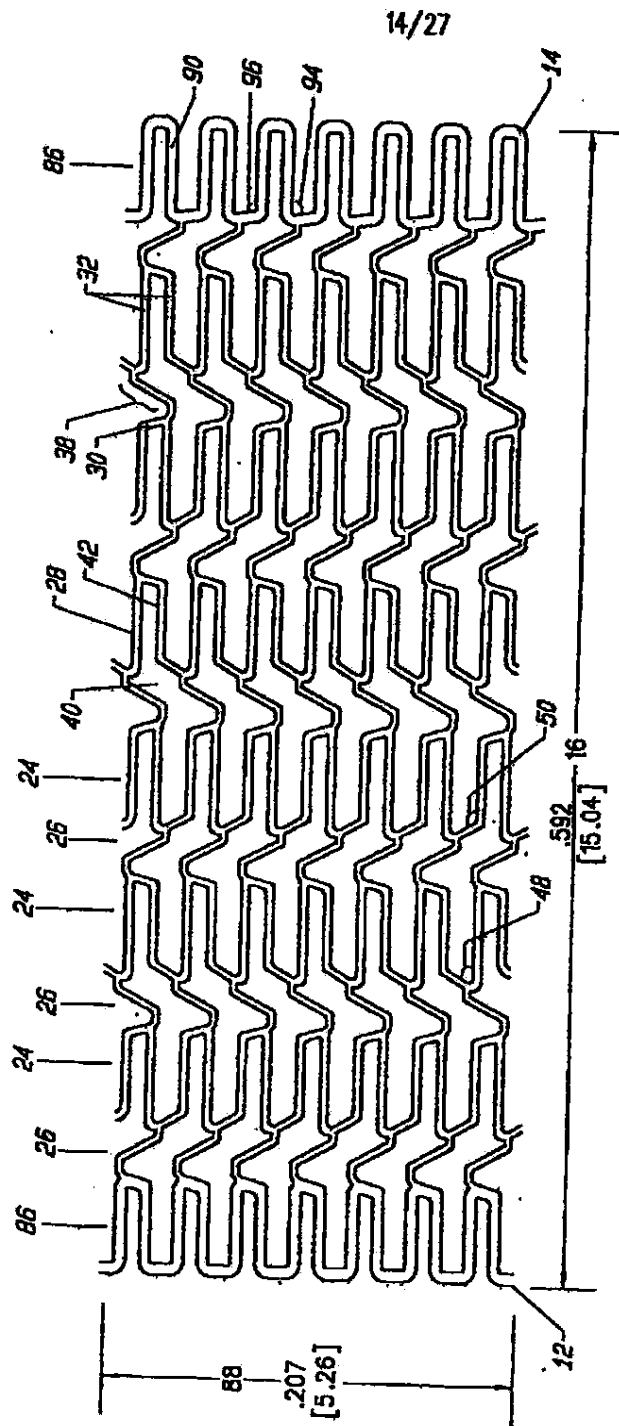
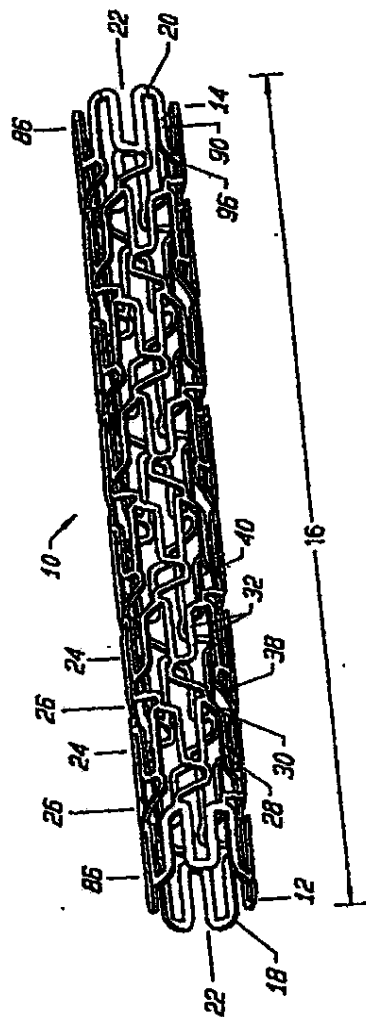


FIG. 8D

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FIG. 8E



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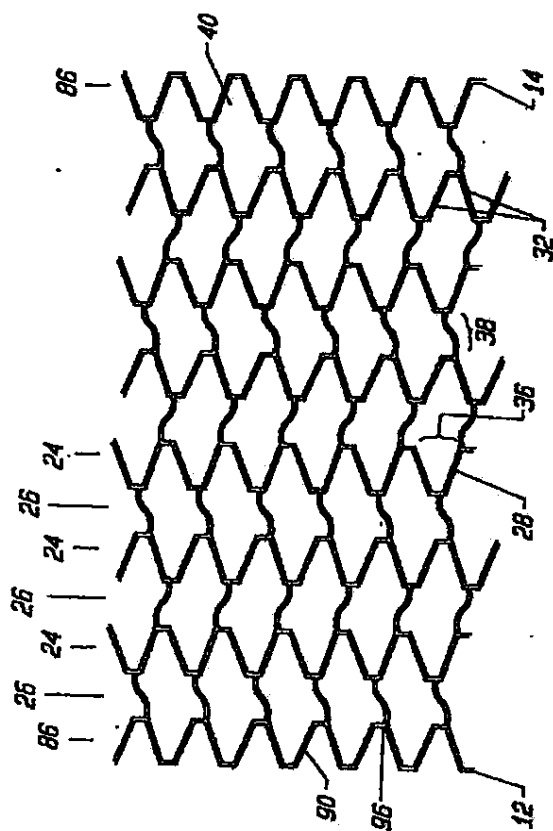


FIG. 8F

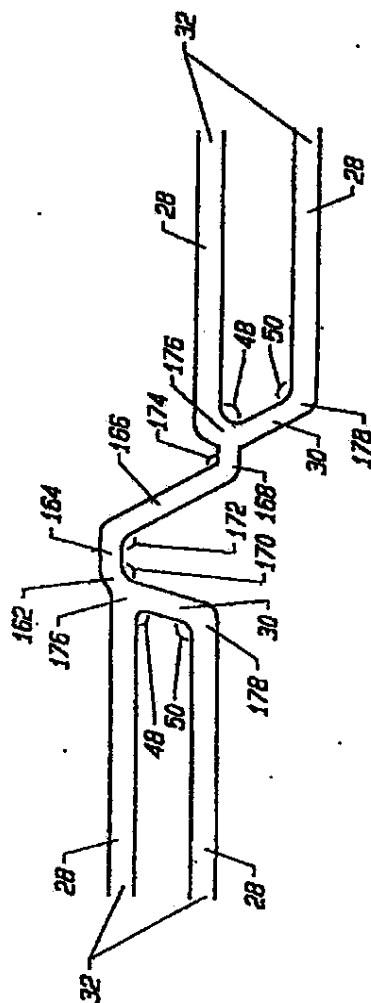


FIG. 8G

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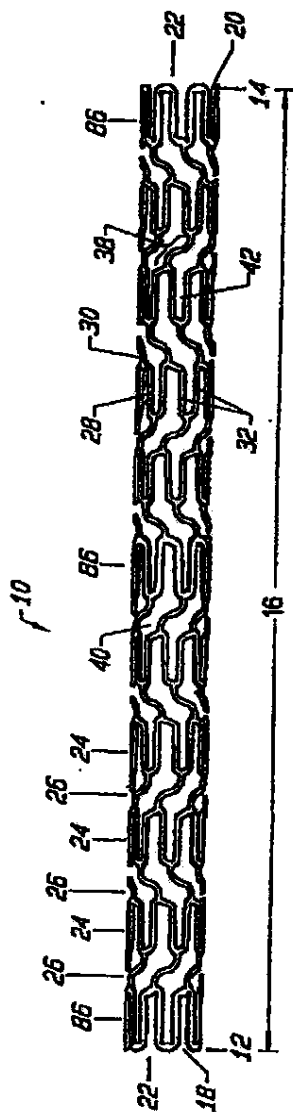


FIG. 9A

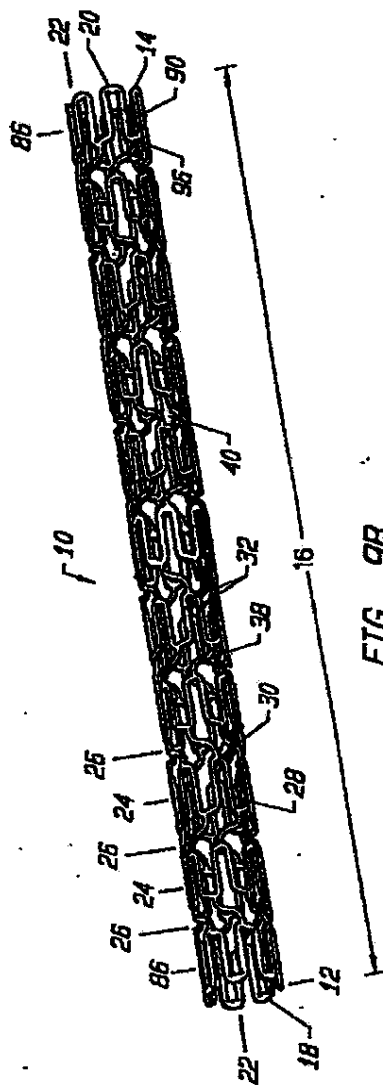


FIG. 9B

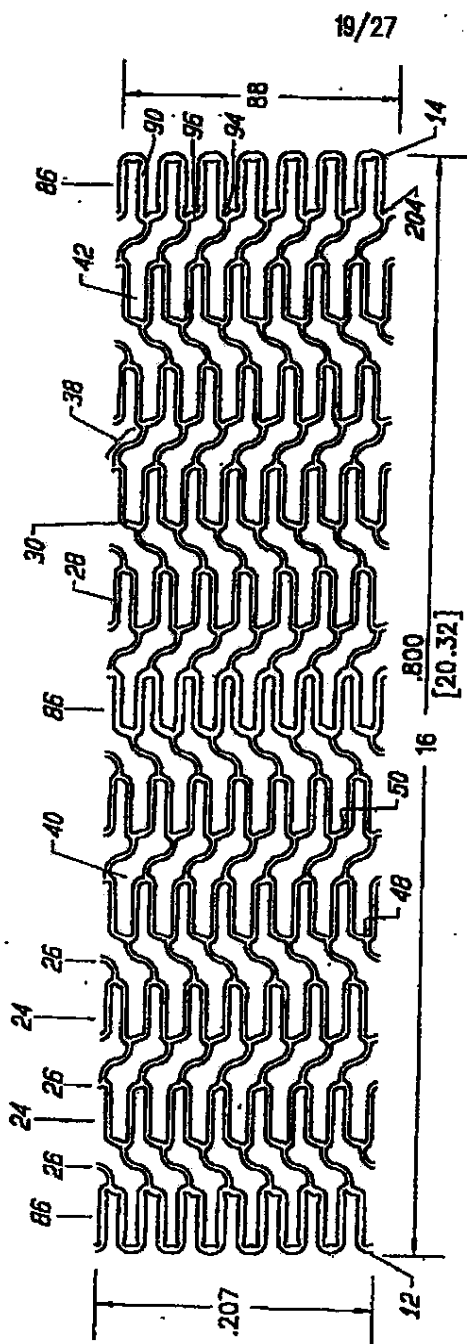


FIG. 9C

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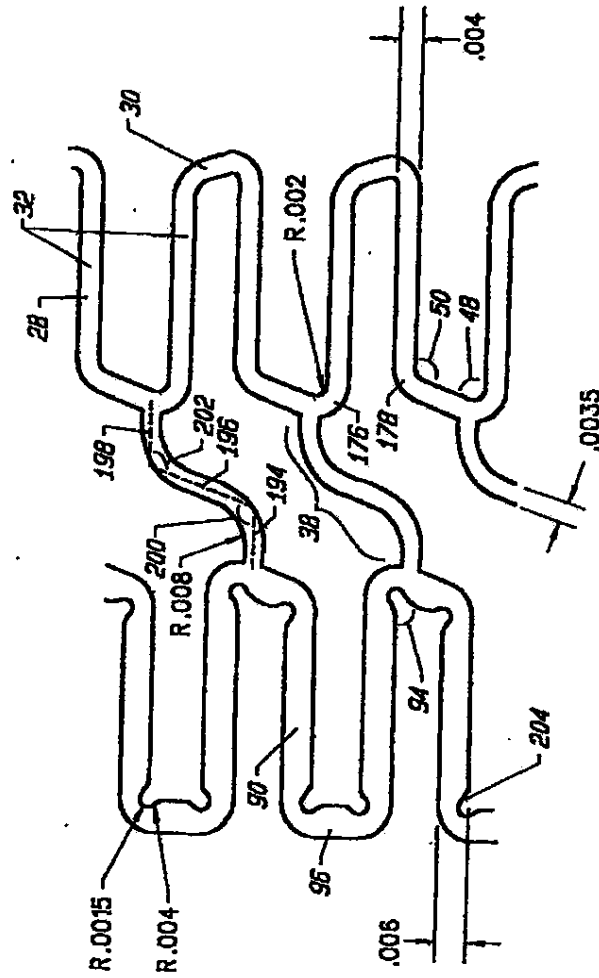


FIG. 90

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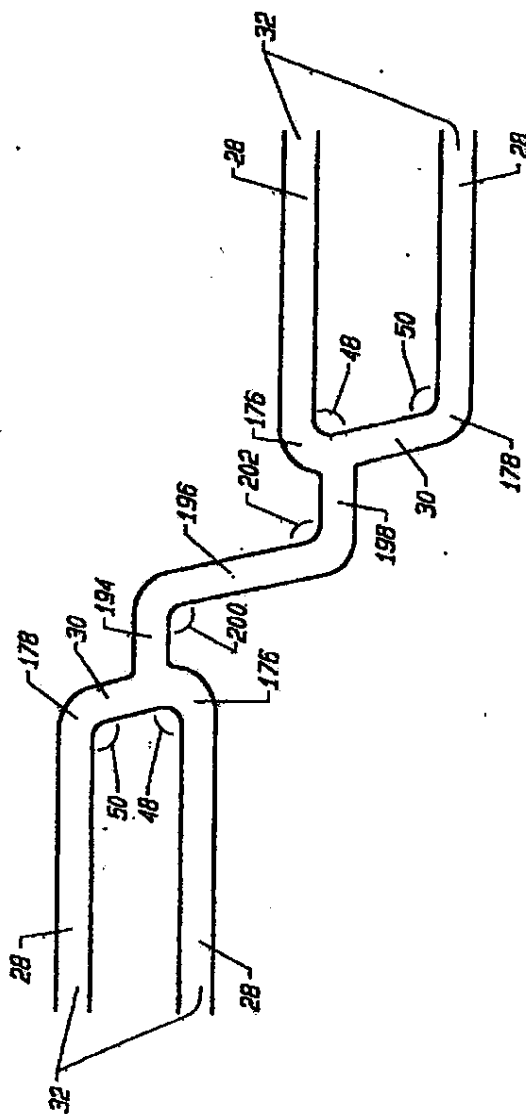


FIG. 9E

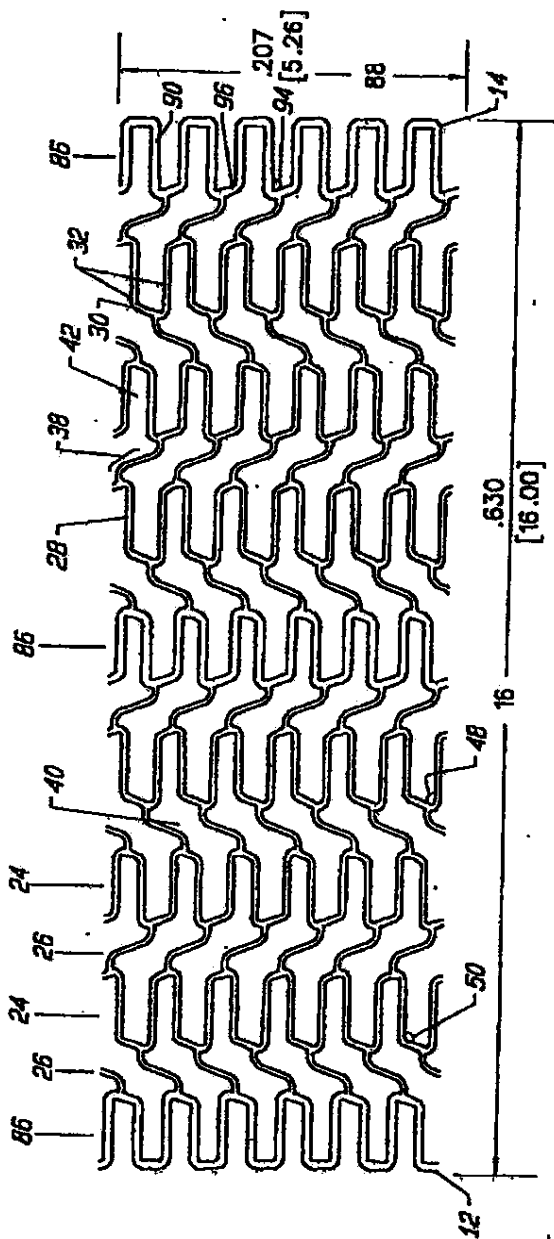
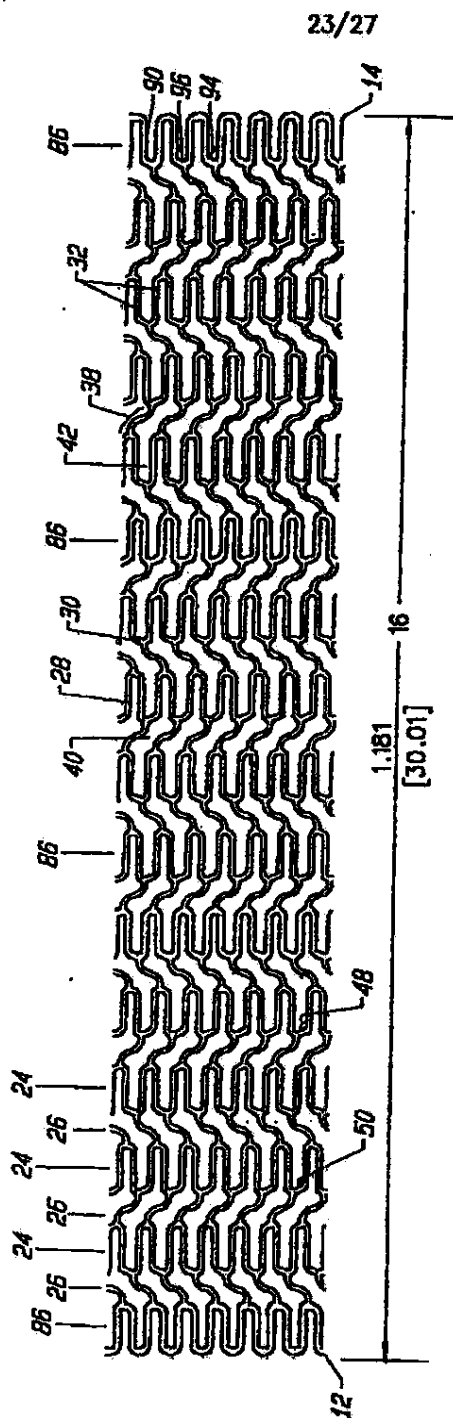


FIG. 9F



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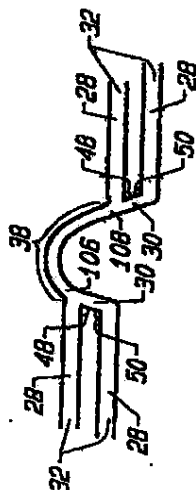


FIG. 10A

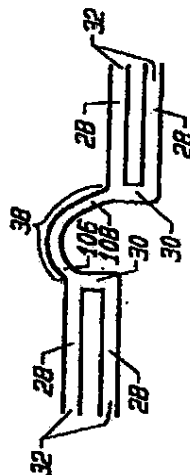


FIG. 10B

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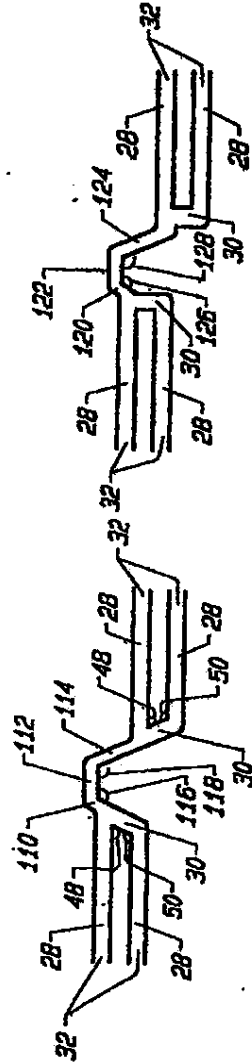


FIG. 10C

FIG. 10D

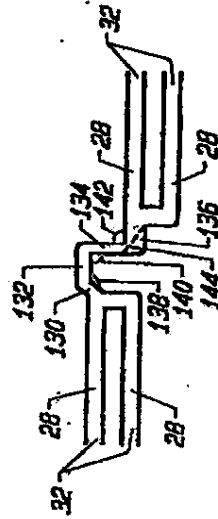


FIG. 10E

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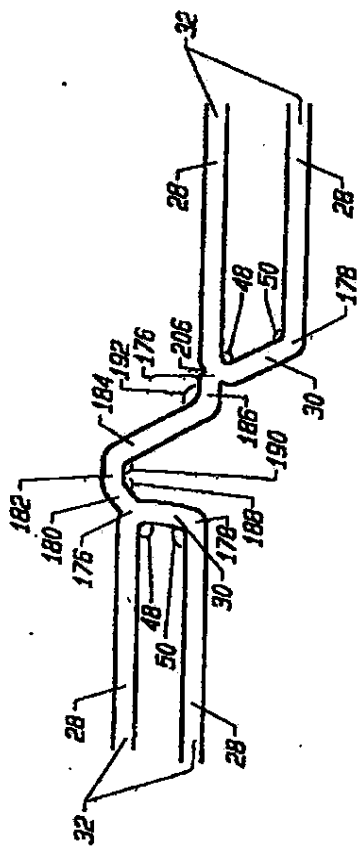


FIG. 10F

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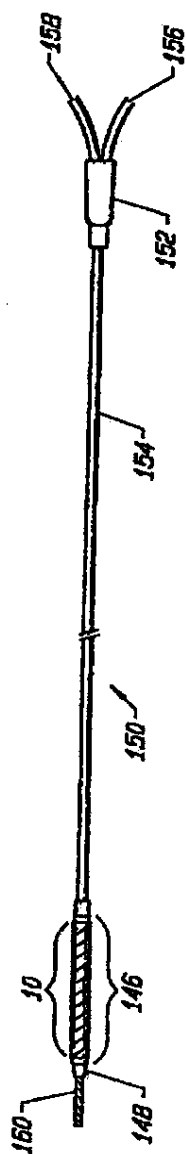


FIG. 11

PART B - ISSUE FEE TRANSMITTAL

Complete and mail this form, together with applicable fee, to:

Box ISSUE FEE
Assistant Commissioner for Patent
Washington, D.C. 20231

1560

2/25/99

MAILING INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE. Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Issue Fee Receipt, the Patent Office orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Lightly mark up with any corrections or use Block 1)

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WILSON SONSINI GOODRICH & ROSATI
650 PAGE MILL ROAD
PALO ALTO CA 94304-1050

OH31/0218

Note: The certificate of mailing below can only be used for domestic mailings of the Issue Fee Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing.

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I hereby certify that this Issue Fee Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Box Issue Fee address above on the date indicated below.

SIDNEY MANUWALA (Depositor's name)

[Signature]

4-9-99 (Date)

APPLICATION NO.	FILING DATE	TOTAL CLAIMS	EXAMINER AND GROUP ART UNIT	DATE MAILED
09/845,657	04/25/97	085	NGUYEN, T	3738 02/18/
First Named Applicant	JANG,	35 USC 152(b) term ext. =	0 Days.	

TITLE OF INVENTION INTRAVASCULAR STENT

ATTY'S DOCKET NO.	CLASS-SUBCLASS	BATCH NO.	APPL. TYPE	SMALL ENTITY	FEE DUE	DATE DUE
3	18461.709	623-001.000	P32 UTILITY	YES	605.00 \$1,210.00	05/18/

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.263). Use of PTO form(s) and Customer Number are recommended, but not required.

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" indication form PTO/SB/47) attached.

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1. Wilson Sonsini
Goodrich & Rosati

2.

3.

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)
PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Indication of assignee data is only appropriate when an assignment has been previously submitted to the PTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

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Please check the appropriate assignee category indicated below (will not be printed on the patent)

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
08/843,657	04/25/1997	G. DAVID JANG	18461.709	8399

21971 7306 12202001

WILSON SONSINI GOODRICH & ROSATI
 650 PAGE MILL ROAD
 PALO ALTO, CA 943041050

EXAMINER

NGUYEN, TRAM A

AAT UNIT

PAPER NUMBER

3738

DATE MAILED: 12/20/2001

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

JFH 000259



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Patent and Trademark Office
ASSISTANT COMMISSIONER FOR PATENTS
Washington, D.C. 20231


Paul Davis
Wilson, Sonsini, Goodrich & Rosati
650 Page Mill Road
Palo Alto, CA 94304-1050

You are hereby notified under 37 CFR 1.607(d) that an applicant is seeking to provoke an interference with your U.S. Patent No. 5,922,021.

The identity of the applicant will not be disclosed unless an interference is declared.

If a final decision is made not to declare an interference, a notice to that effect will be placed in the patent file and will be sent to the patentee.

If an interference is declared, notice thereof will be made under 37 CFR 1.611.


Paul Prebille
Primary Examiner
Art Unit 3738
(703) 308-2905

**Attachment for PTO-948 (Rev. 03/01, or earlier)
6/18/01**

**The below text replaces the pre-printed text under the heading,
"Information on How to Effect Drawing Changes," on the back
of the PTO-948 (Rev. 03/01, or earlier) form.**

INFORMATION ON HOW TO EFFECT DRAWING CHANGES

1. Correction of Informalities -- 37 CFR 1.85

New corrected drawings must be filed with the changes incorporated therein. Identifying indicia, if provided, should include the title of the invention, inventor's name, and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and centered within the top margin. If corrected drawings are required in a Notice of Allowability (PTOL-37), the new drawings **MUST** be filed within the **THREE MONTH** shortened statutory period set for reply in the Notice of Allowability. Extensions of time may **NOT** be obtained under the provisions of 37 CFR 1.136(a) or (b) for filing the corrected drawings after the mailing of a Notice of Allowability. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

2. Corrections other than Informalities Noted by Draftsperson on form PTO-948.

All changes to the drawings, other than informalities noted by the Draftsperson, **MUST** be made in the same manner as above except that, normally, a highlighted (preferably red ink) sketch of the changes to be incorporated into the new drawings **MUST** be approved by the examiner before the application will be allowed. No changes will be permitted to be made other than correction of informalities, unless the examiner has approved the proposed changes.

Timing of Corrections

Applicant is required to submit the drawing corrections within the time period set in the attached Office communication. See 37 CFR 1.85(a).

Failure to take corrective action within the set period will result in **ABANDONMENT** of the application.

PATENT APPLICATION FEE DETERMINATION RECORD Effective October 1, 1997					Application or Docket Number	
CLAIMS AS FILED - PART I						
(Column 1)		(Column 2)			(Column 3)	
FOR	NUMBER FILED	NUMBER EXTRA				
BASIC FEE						
TOTAL CLAIMS		86 minus 20 = 66				
INDEPENDENT CLAIMS		2 minus 3 =				
MULTIPLE DEPENDENT CLAIM PRESENT						
* If the difference in column 1 is less than zero, enter "0" in column 2						
					SMALL ENTITY TYPE <input type="checkbox"/>	
					OR OTHER THAN SMALL ENTITY	
					RATE	FEE
					395.00	790.00
					x\$11=	726
					x41=	
					+135=	
					TOTAL	1,121
CLAIMS AS AMENDED - PART II						
(Column 1)		(Column 2)		(Column 3)		
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		
	Total	*	Minus	**	=	
	Independent	*	Minus	***	=	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					
(Column 1)		(Column 2)		(Column 3)		
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		
	Total	*	Minus	**	=	
	Independent	*	Minus	***	=	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					
(Column 1)		(Column 2)		(Column 3)		
AMENDMENT C	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		
	Total	*	Minus	**	=	
	Independent	*	Minus	***	=	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM					
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.						
** If the "Highest Number Previously Paid For" in THIS SPACE is less than 20, enter "20."						
*** If the "Highest Number Previously Paid For" in THIS SPACE is less than 3, enter "3."						
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.						
					SMALL ENTITY TYPE <input type="checkbox"/>	
					OR OTHER THAN SMALL ENTITY	
					RATE	ADDITIONAL FEE
					x\$11=	
					x41=	
					+135=	
					TOTAL	ADDIT. FEE
					OR OTHER THAN SMALL ENTITY	
					RATE	ADDITIONAL FEE
					x\$11=	
					x41=	
					+135=	
					TOTAL	ADDIT. FEE

FORM PTO-875 (Rev. 8/97)

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